NODAWAY RIVER

WATERSHED
INVENTORY AND ASSESSMENT

This information is based on the

Nodaway River Watershed Inventory and Assessment

written by

Rick Horton, Fisheries Biologist

and

Harold Kerns, Northwest Fisheries Regional Supervisor

For additional information contact

Northwest Regional Fisheries staff

701 NE College Drive, St. Joseph, Missouri 64507

EXECUTIVE SUMMARY

The Nodaway River is a low gradient, sixth order river located in southwest Iowa and northwest Missouri. The Nodaway River originates in Adair County, Iowa and flows southward for about 120 miles where it empties into the Missouri River near the town of Nodaway, Missouri. The watershed drains 1,820 square miles [68% in Iowa (1,230 mi^2) and 32% in Missouri (590 mi^2)]. The Nodaway River basin lies entirely within the Dissected Till Plains physiographic region. The average annual discharge for the Nodaway River measured at Graham, Missouri (76% of the drainage basin) is 1,018 cubic feet per second. There are 156 third order and larger streams within the basin. Major tributaries in the Nodaway River basin are Seven Mile Creek, West Nodaway River, East Nodaway River, Middle Nodaway River, Clear Creek, Mill Creek, Elkhorn Creek, and Arapahoe Creek. Drainages in the basin are typical of altered prairie streams (i.e. turbid water and substrates of silt and sand).

The basin is rural with Clarinda, Iowa (population 5,104; 1990 Census) being the largest city in the watershed. Land use in the basin is dominated by agriculture (70 % row crop, 17 % pasture, and 6 % forest). Only one percent of the watershed is in public ownership. Extensive

channelization has eliminated 248 miles of stream. The larger streams (fourth, fifth, and sixth order) have had over sixty percent of their mileage altered, and a reduction in total stream miles of thirty percent.

Non-point source pollution (primarily siltation and sediment) is the major threat to basin waters. Soil loss from basin lands coupled with sediment deposition in stream channels has magnified high and low flow conditions. This limits the diversity and abundance of aquatic fauna in the Nodaway River basin. Increased numbers of large concentrated animal feeding operations are a new threat to basin waters.

Surveys conducted by Missouri Department of Conservation personnel, Iowa Department of Natural Resources personnel, and angler creel records have documented 47 species of fish within the basin. Wide ranging, tolerant species are the most common, with minnows of the Cyprinidae family being dominant. Fish of interest to anglers include channel catfish, common carp, largemouth bass, white crappie, sauger, bluegill, and green sunfish. A statewide creel survey in Missouri, conducted in the 1940's and 1950's found channel catfish and common carp the most frequently harvested fish in the Nodaway River. Recent angler surveys, for basin waters, are lacking. Eight species, currently state listed as endangered by Iowa and/or Missouri, inhabit or were at one time found in the Nodaway River basin.

Private ownership accounts for 99 % of basin lands, making private landowners a critical link in improving streams. The main objective should be to improve public perception of stream resources within the basin. This would allow all of the goals in this plan to be met. The main goals listed are: Improved water quality and quantity, improved riparian and aquatic habitats, preservation of a diverse native aquatic community, increased public appreciation for and awareness of area stream resources, and increased recreational use.

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The Nodaway River originates near the town of Fontanelle in southwestern Iowa as the Middle Nodaway River. The Middle Nodaway flows southwest to join the West Nodaway just below Villisca, Iowa. The East and West Nodaway join to form the mainstem Nodaway River four miles north of the Iowa-Missouri border and the river enters Missouri near Clearmont, Missouri. The mainstem river flows in a southerly direction about 60 miles to its confluence with the Missouri River near the town of Nodaway, Missouri (Figure 1). Major tributaries of the Nodaway River include Seven Mile Creek, Middle Nodaway River, East Nodaway River, and West Nodaway River in Iowa and Clear Creek, Mill Creek, Elkhorn Creek, and Arapahoe Creek in Missouri. The Nodaway River peak elevation is 1,400 feet mean sea level (M.S.L.) at its headwaters and 800 feet M.S.L. at the mouth.

The Nodaway River basin encompasses parts of 10 counties in southwestern Iowa and northwestern Missouri. Iowa's portion of the basin is located in Adair, Adams, Cass, Montgomery, Page, Taylor, and Union counties while in Missouri the basin covers portions of Andrew, Holt, and Nodaway counties. The population in the Nodaway basin has declined slowly and steadily since the 1950's. In 1970 there were approximately 35,000 people living in the basin. Clarinda, Iowa was the largest city with a population of about 5,500 people (USCOE 1973). Population in the basin as of the 1990 U.S. population census was 28,779 with the largest city in the basin still being Clarinda, Iowa (population 5,104).

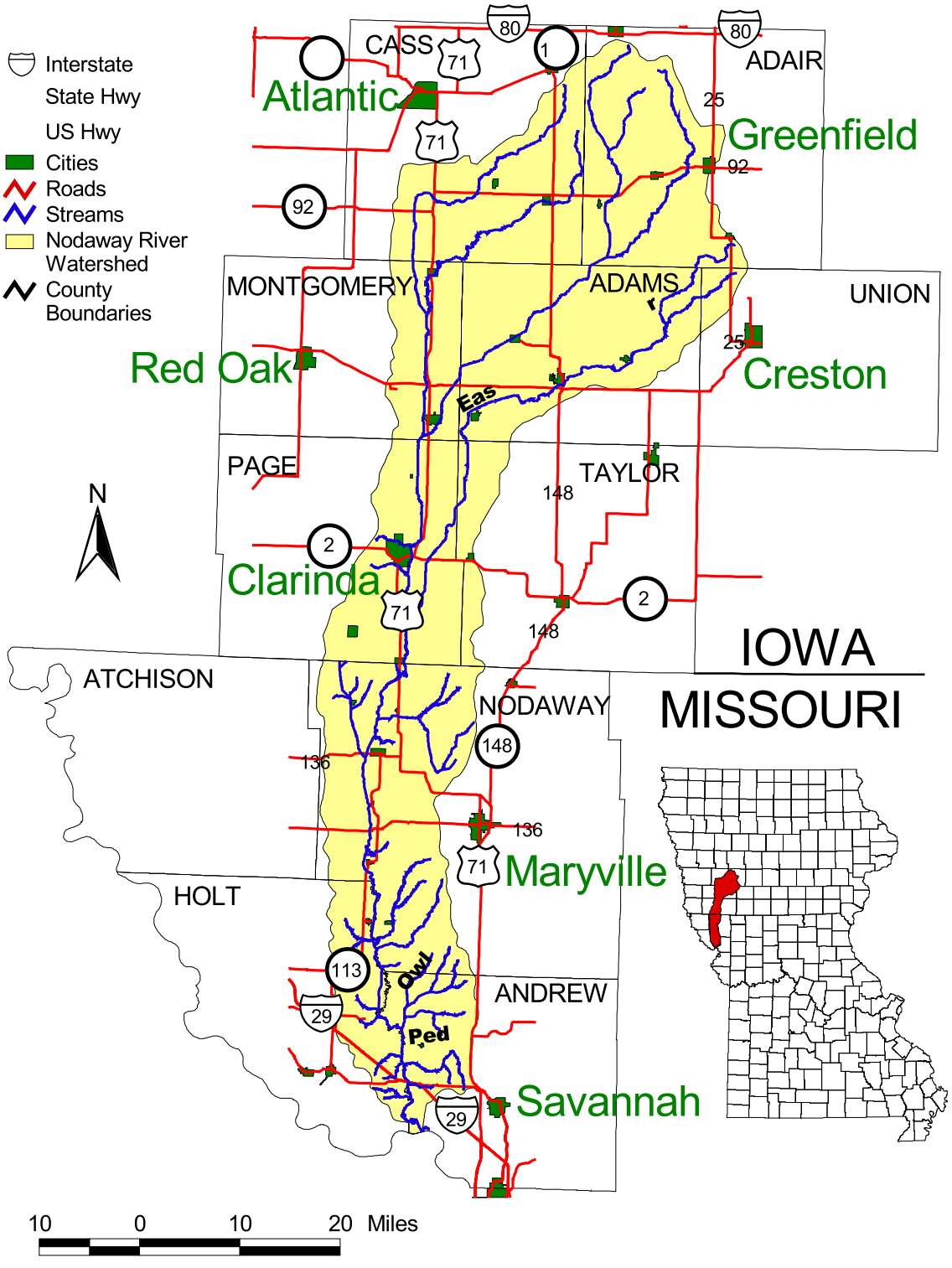


Figure 1. Location of Nodaway River watershed.

GEOLOGY

PHYSIOGRAPHIC REGION

The majority of the Nodaway River basin lies within the Western Glaciated Plains Natural Division with a small area near the mouth in the Big Rivers Upper Missouri Natural Division (Figure ND) (Thom and Wilson 1980). The entire basin is in the Dissected Till Plains (MDNR 1986a). The basin topography consists of rolling to hilly glacial plains divided by wide, level stream valleys. In the Iowa portion of the basin, most divides are rounded and parallel to the regional northeast-southwest drainage. Steep irregular loess mounds, formed from wind blown glacial outwash, border the Missouri River flood plain near the mouth of the Nodaway River.

GEOLOGY AND SOILS

The basin soils overlay Cretaceous and Pennsylvanian deposited sedimentary bedrocks (Figure GE). The Pennsylvanian-aged formations consist primarily of sandstone, shale, limestone and thin seams of coal (USDA 1981).

Most basin soils are formed from glacial till (a mixture of clay, rock, gravel and sand), alluvium (water deposited soil), and a windblown silt called loess. The soils have their origin in the four periods of continental glaciation with deposits from the final glacial advance (Kansan) overlying earlier deposits. The topography of this region is the youngest in the state of Missouri. When glaciation ceased, the area was covered with a relatively level drift plain. After the last glaciation a thick layer of loess was deposited over the basin. Loess deposits in the basin are some of the deepest in Missouri, ranging from 10 - 30 feet in depth. The depth of the till is highly variable, but it generally ranges between 200 and 400 feet, obscuring most of the bedrock in the region. Occasional pockets or channels of sand are found in the till strata. Glacial sand and gravel may underlie the till (USDA-SCS 1982).

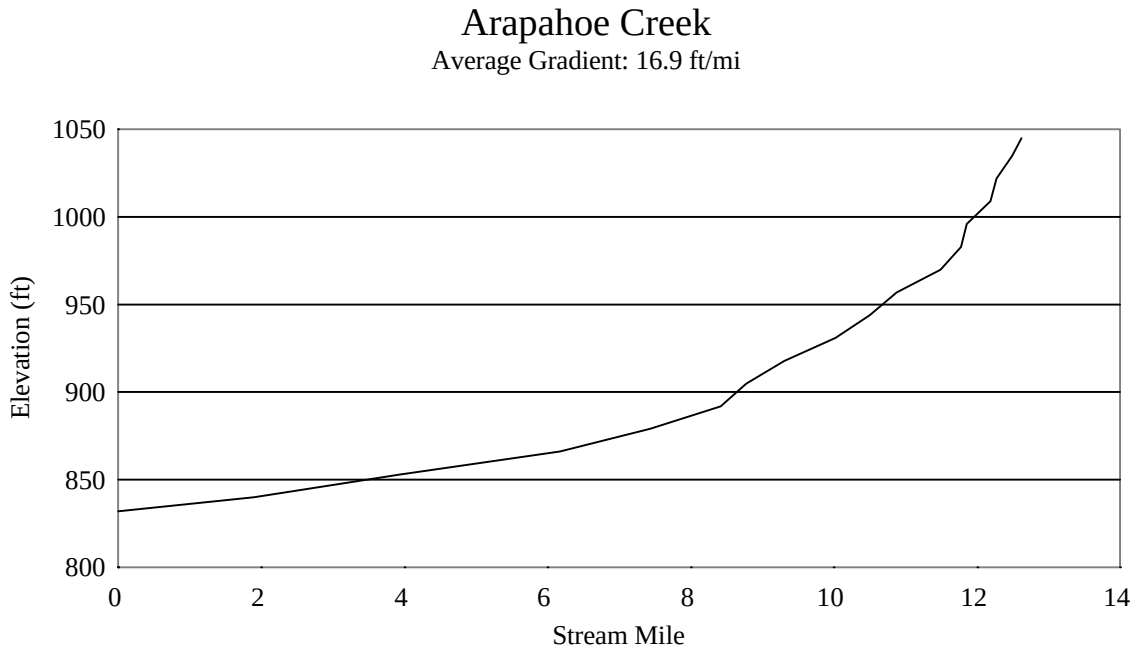
Loess soils cover broad, gently sloping ridges of silty loam and are suitable for farming. Glacial soil occurs on steeper, eroding slopes and it is a less productive brown loam or gritty silt loam. Valleys are covered with alluvial silt and clay loams, and are the most productive soils in the basin (USDA-SCS 1982).

WATERSHED AREA

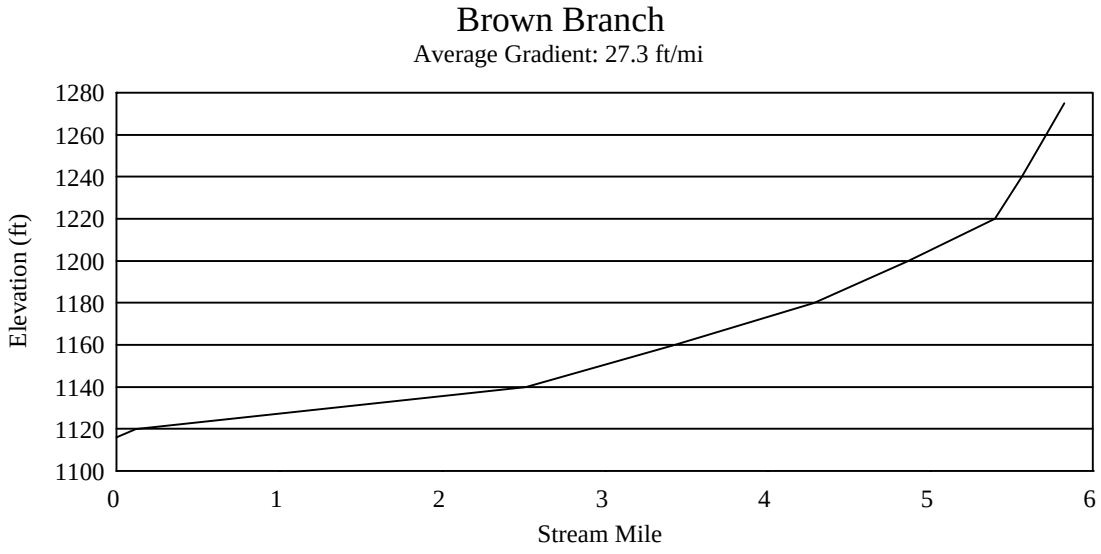
The Nodaway River is a sixth order river with a basin area of 1,820 square miles. The basin covers portions of southwestern Iowa and northwestern Missouri, with 1,230 square miles (68%) in Iowa and 590 square miles (32%) in Missouri. The Nodaway River basin is bound by the Platte River basin to the east and the Grand River and Des Moines River basins to the northeast, with the latter defining the boundary between the Missouri River and Mississippi River basins. The west side is bound by the Tarkio River basin, the northwest by the Nishnabotna River basin, and minor Missouri River tributaries to the southwest. The basin is about 115 miles in length. It averages 12 miles in width in the lower two-thirds and has a maximum width of 35 miles near the upper end. The flood plain width varies between one-half and two and one-half miles. The Nodaway River basin is prone to extensive flooding due to poor land use practices and its tapered top heavy shape (USCOE 1973).

CHANNEL GRADIENT

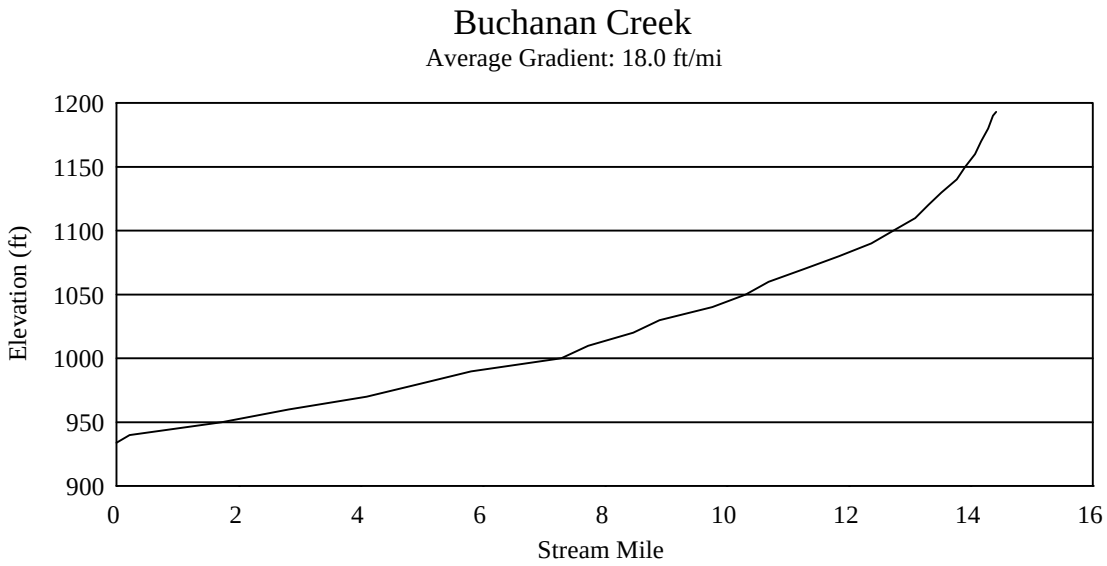
There are 156 third order and larger streams within the basin. Gradient information was calculated using USGS 7.5 minute topographic maps. Gradient information for all streams fourth order and larger are found in Appendix A. The Nodaway River was described as a low gradient river with a gradient of two to six feet per mile (USCOE 1973). Current gradient plots including the three main branches (East, Middle, and West Nodaway rivers) in Iowa range from 2.0 to 6.2 feet per mile indicating there has probably been little change in gradient over the past 25 to 30 years. Gradient in the lower 64 miles of the Nodaway River (confluence of the East and West Nodaway rivers to the confluence with the Missouri River) is virtually constant at 2.0 feet per mile. Average gradient values for fifth order streams range from 5.5 to 16.9 feet per mile. Fourth order stream gradients range from 7.6 to 45.0 feet per mile. As a general rule, shorter streams have higher average gradients.



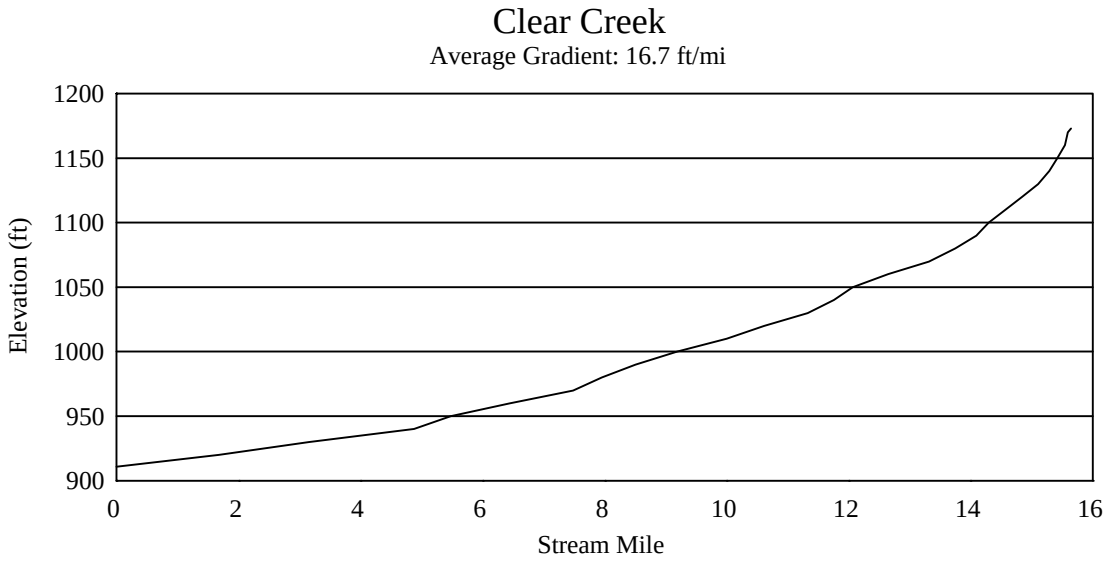
Appendix A. Gradient plot for Arapahoe Creek, a 5th order tributary of the Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 61, Range 36 and Section 31. The stream is located on 7.5 minute quadrangle maps New Point, Fillmore, and Bolckow NW.



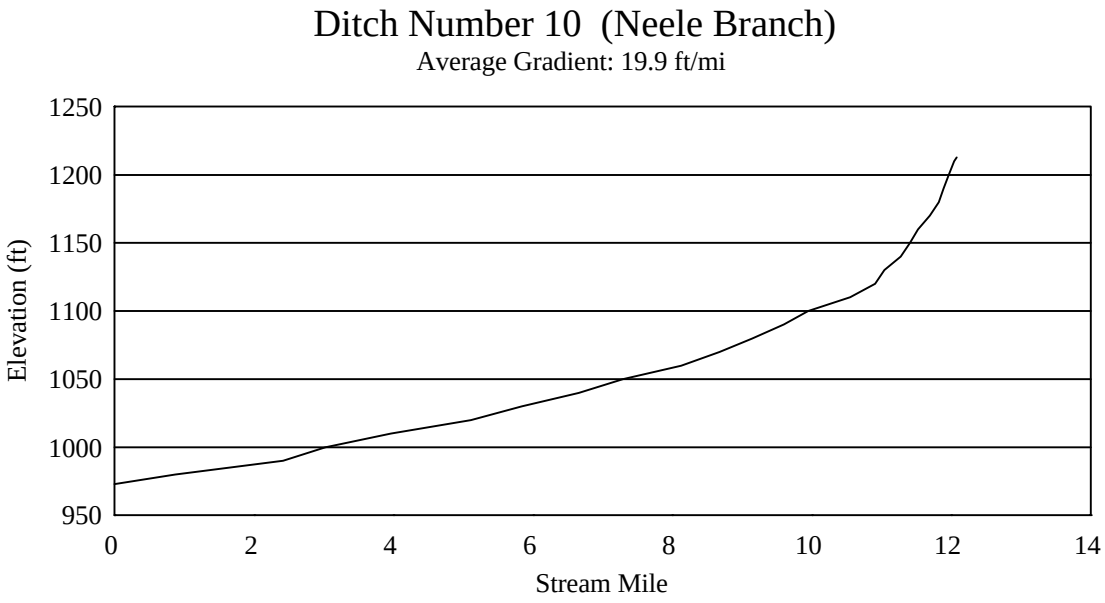
Appendix A. Gradient plot for Brown Branch, a 4th order tributary of the East Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 72, Range 33 and Section 29. The stream is located on 7.5 minute quadrangle map Corning North.



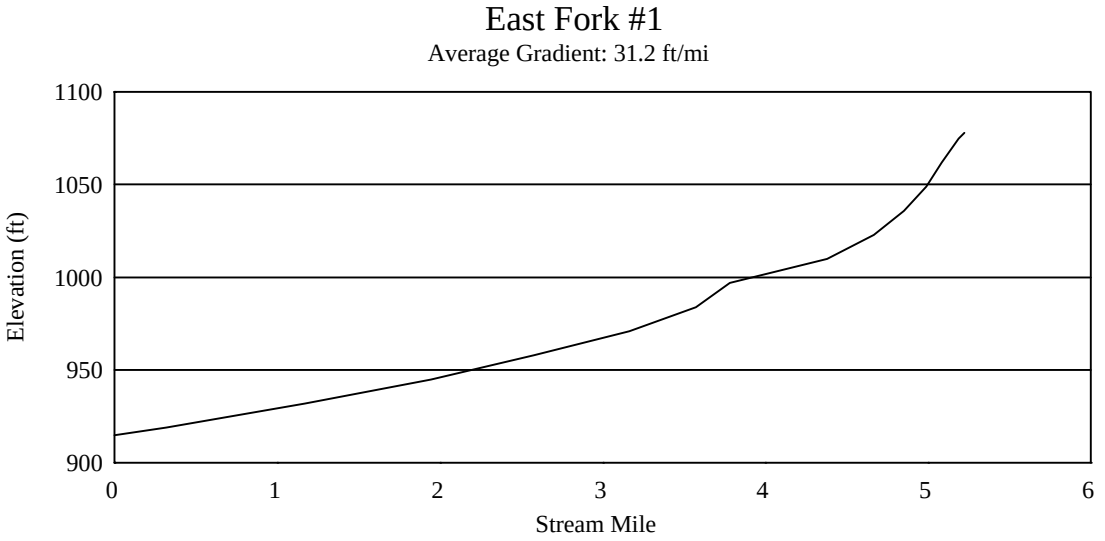
Appendix A. Gradient plot for Buchanan Creek, a 4th order tributary of the Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 67, Range 36 and Section 19. The stream is located on 7.5 minute quadrangle maps Clearmont, Hopkins SW, and New Market.



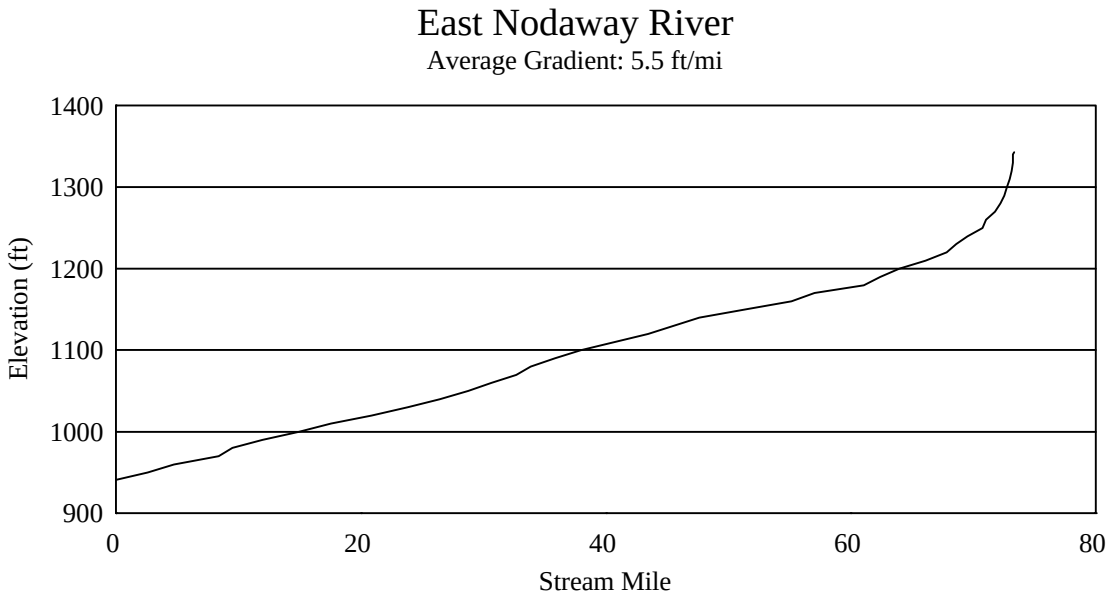
Appendix A. Gradient plot for Clear Creek, a 5th order tributary of the Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 66, Range 37 and Section 27. The stream is located on 7.5 minute quadrangle maps Burlington Junction, Clearmont, Wilcox and Hopkins SW.



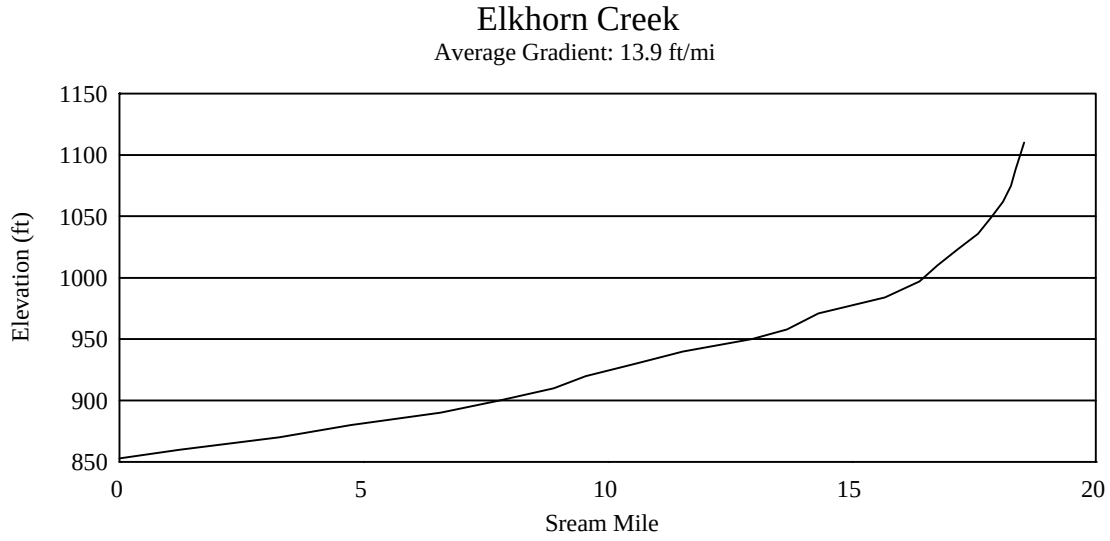
Appendix A. Gradient plot for Ditch Number 10 (Neele Branch), a 4th order tributary of the West Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 69, Range 36 and Section 16. The stream is located on 7.5 minute quadrangle maps Hawleyville, Clarinda North, and Stanton.



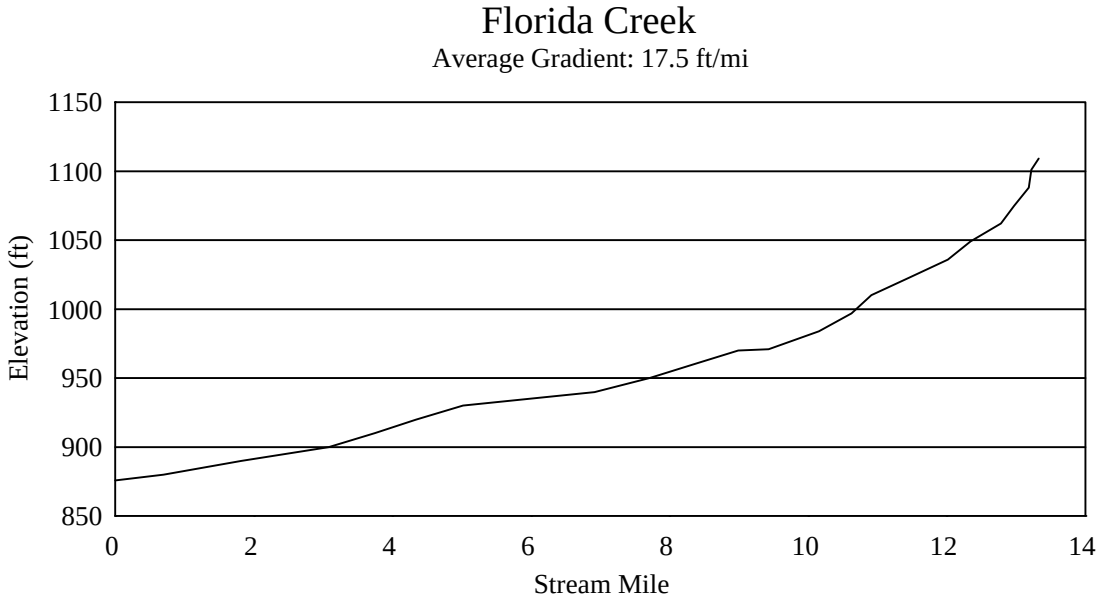
Appendix A. Gradient plot for East Fork Number 1, a 4th order tributary of Jenkins Creek in the Nodaway River watershed. The location of the mouth is at Township 62, Range 36 and Section 8. The stream is located on 7.5 minute quadrangle map Bolckow NW.



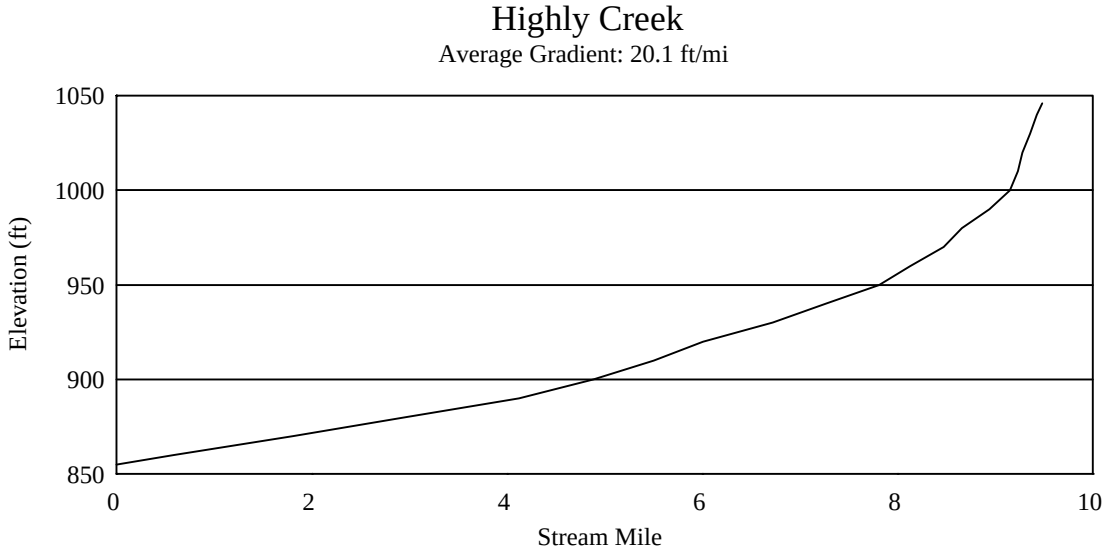
Appendix A. Gradient plot for East Nodaway River, a 5th order tributary of the Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 67, Range 36 and Section 07. The stream is located on 7.5 minute quadrangle maps Clarinda South, New Market, Hawleyville, Villisca, Brooks, Corning South, Corning North, Prescott, Nevinville, and Orient.



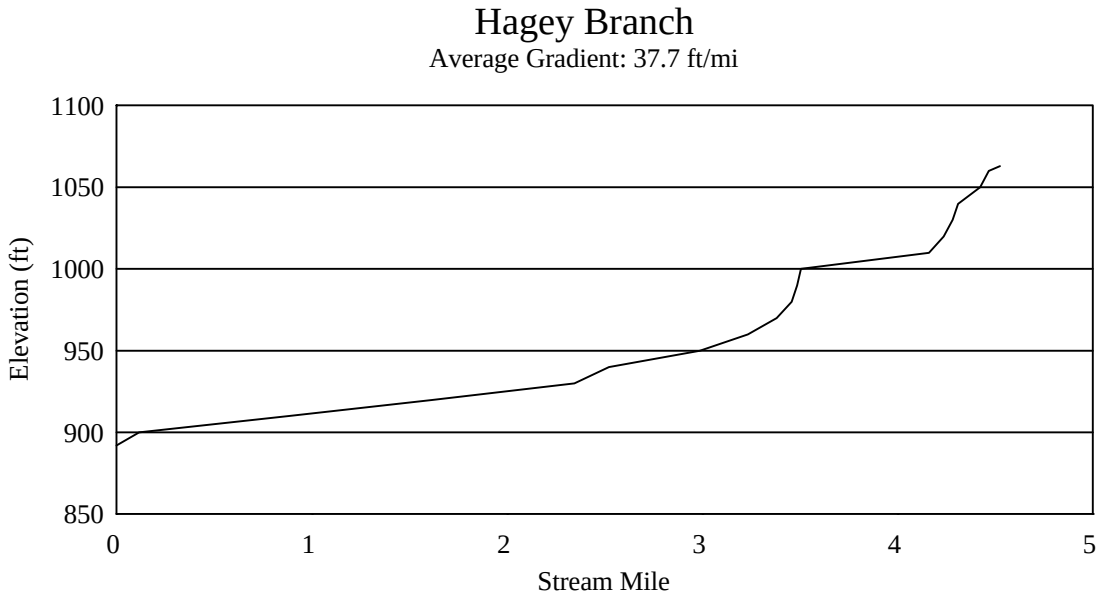
Appendix A. Gradient plot for Elkhorn Creek, a 4th order tributary of the Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 62, Range 37 and Section 22. The stream is located on 7.5 minute quadrangle maps Maitland, Skidmore, and Maryville West.



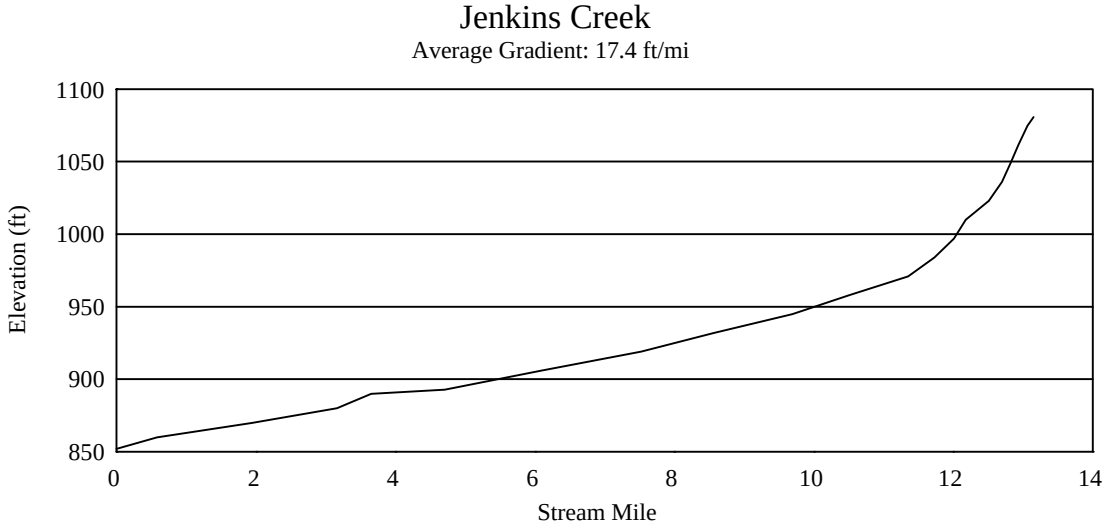
Appendix A. Gradient plot for Florida Creek, a 4th order tributary of the Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 64, Range 37 and Section 33. The stream is located on 7.5 minute quadrangle maps Skidmore, Maryville West, and Wilcox.



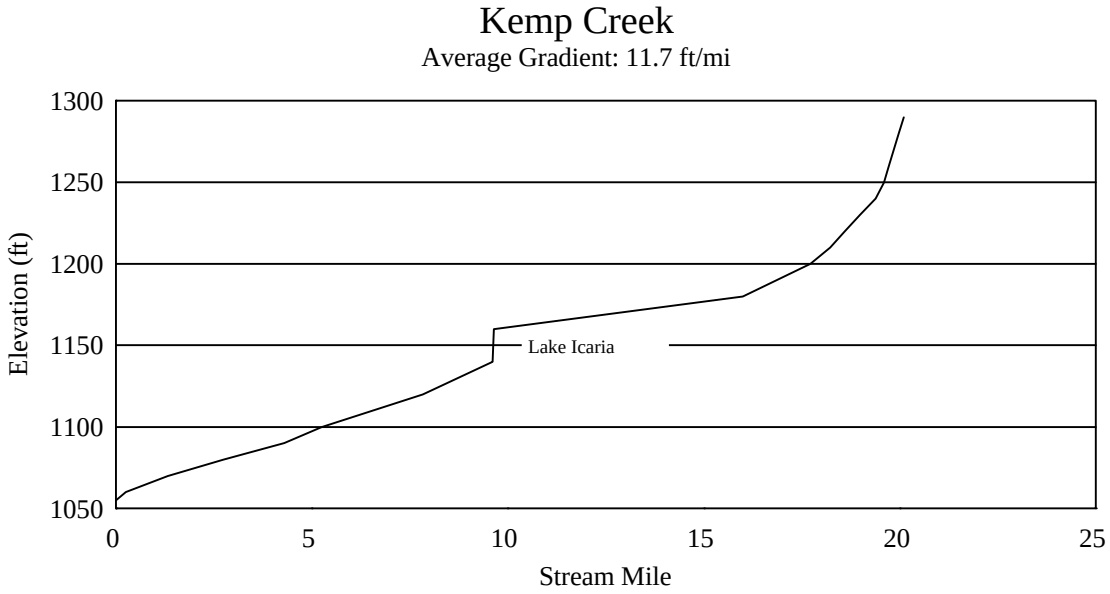
Appendix A. Gradient plot for Highly Creek, a 4th order tributary of the Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 62, Range 37 and Section 16. The stream is located on 7.5 minute quadrangle maps Maitland and Mound City.



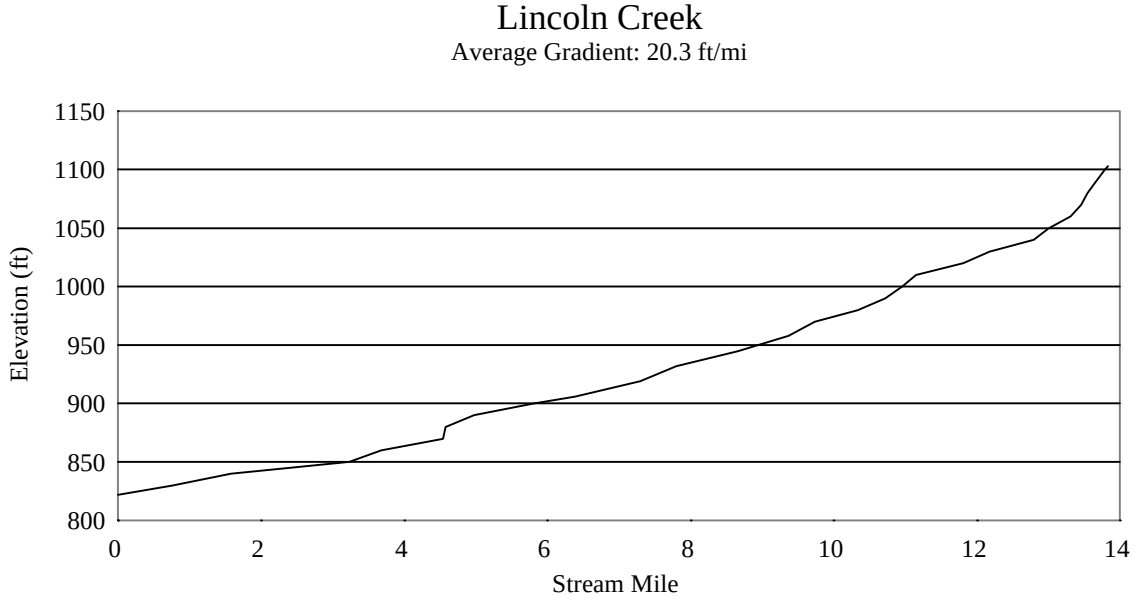
Appendix A. Gradient plot for Hagey Branch, a 3th order tributary of the Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 65, Range 37 and Section 29. The stream is located on 7.5 minute quadrangle maps Burlington Junction and Skidmore NW.



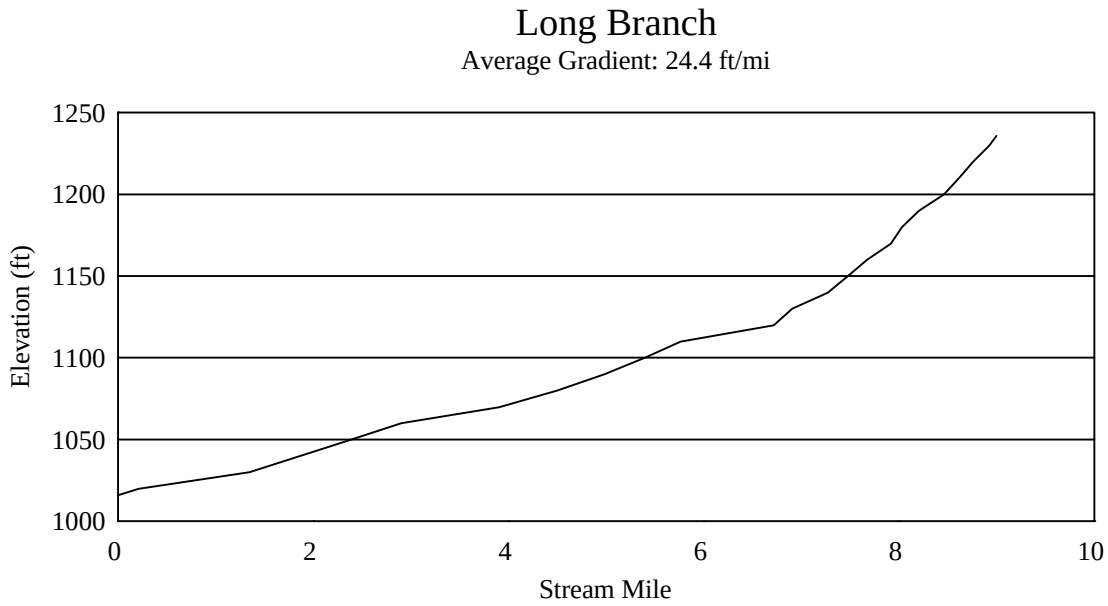
Appendix A. Gradient plot for Jenkins Creek, a 4th order tributary of the Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 62, Range 37 and Section 22. The stream is located on 7.5 minute quadrangle maps Maitland, Bolckow NW, and Maryville West.



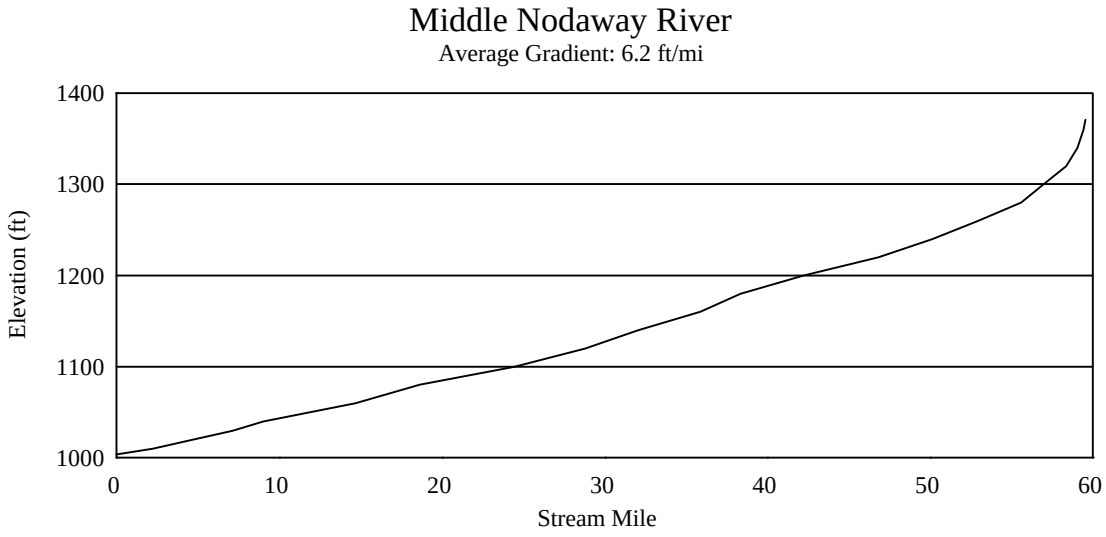
Appendix A. Gradient plot for Kemp Creek, a 4th order tributary of the East Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 71, Range 35 and Section 11. The stream is located on 7.5 minute quadrangle maps Brooks, Carbon, Corning North, Prescott, and Nevinville.



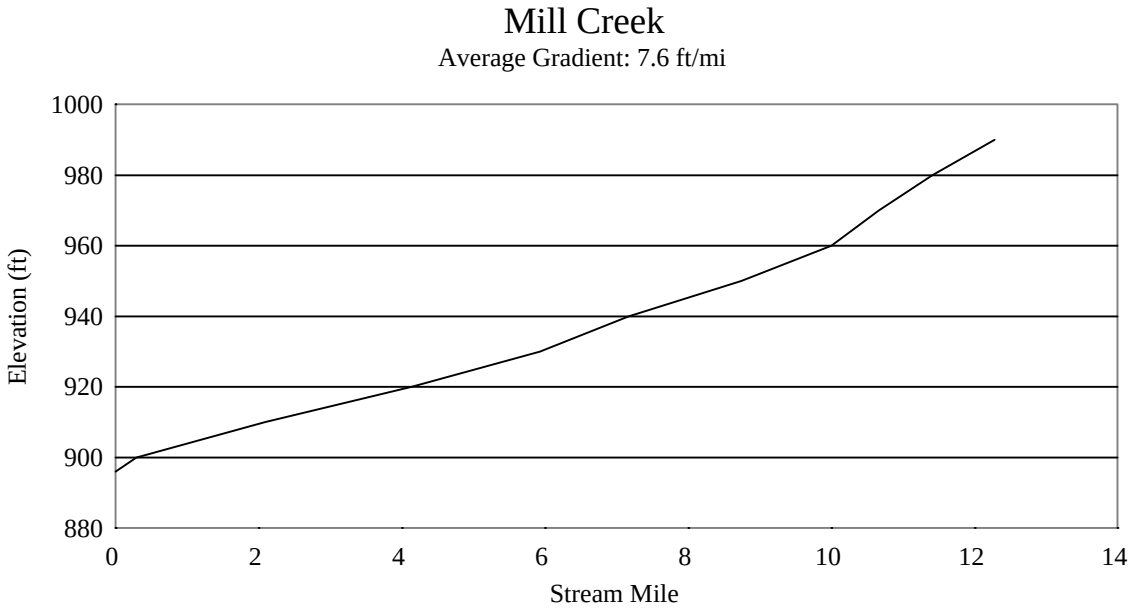
Appendix A. Gradient plot for Lincoln Creek, a 4th order tributary of the Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 60, Range 37 and Section 25. The stream is located on 7.5 minute quadrangle maps Forbes, Amazonia, and Fillmore.



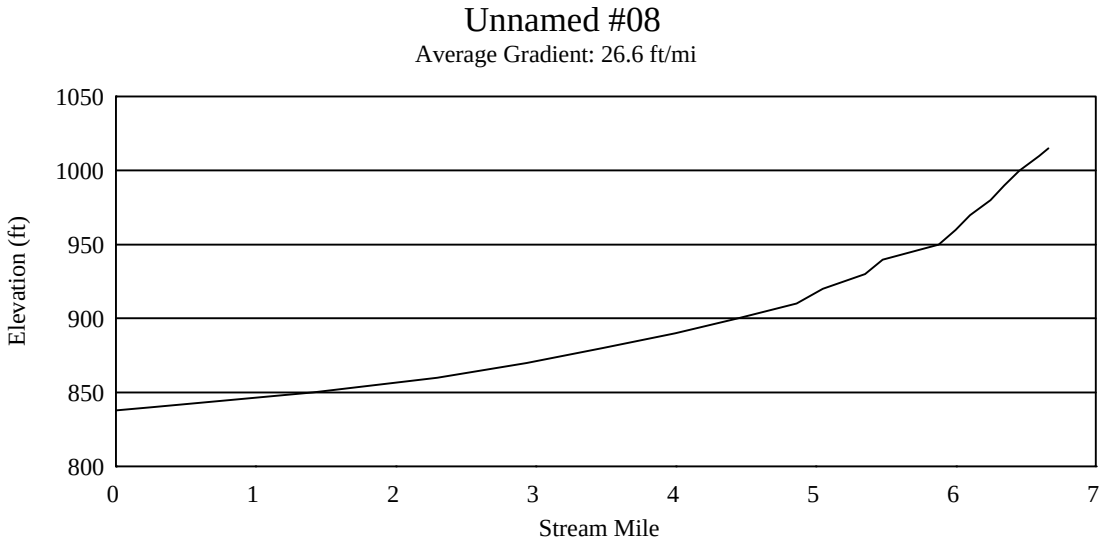
Appendix A. Gradient plot for Long Branch, a 4th order tributary of the East Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 70, Range 35 and Section 17. The stream is located on 7.5 minute quadrangle maps Hawleyville, Villisca, and Brooks.



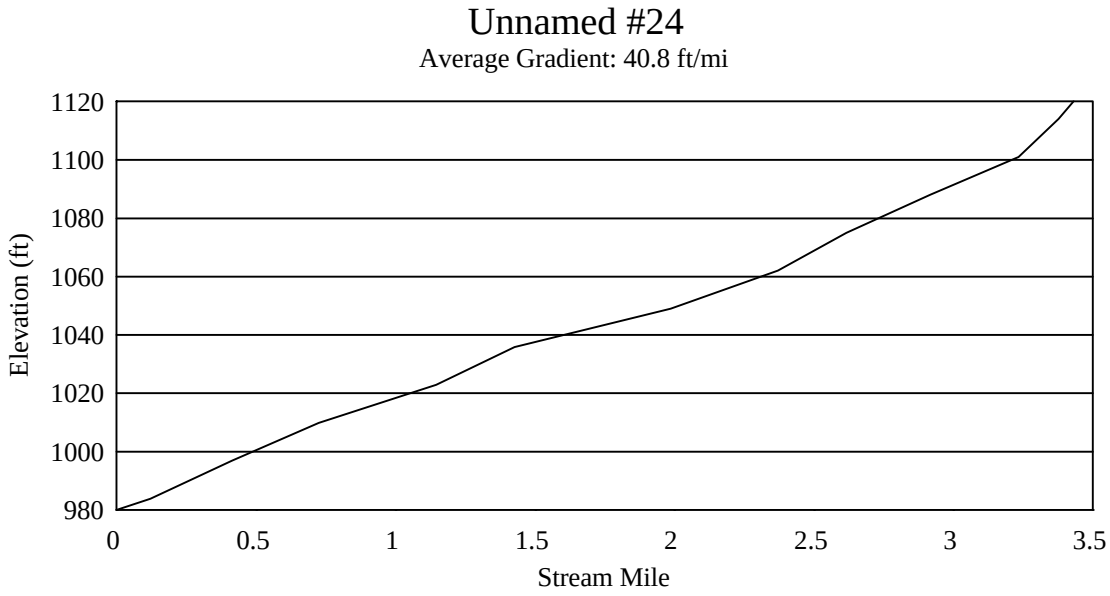
Appendix A. Gradient plot for Middle Nodaway River, a 5th order tributary of the West Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 70, Range 36 and Section 33. The stream is located on 7.5 minute quadrangle maps Villisca, Morton Mills, Carbon, Corning North, Bridgewater, Nevinville, Fontanelle, Greenfield, and Canby.



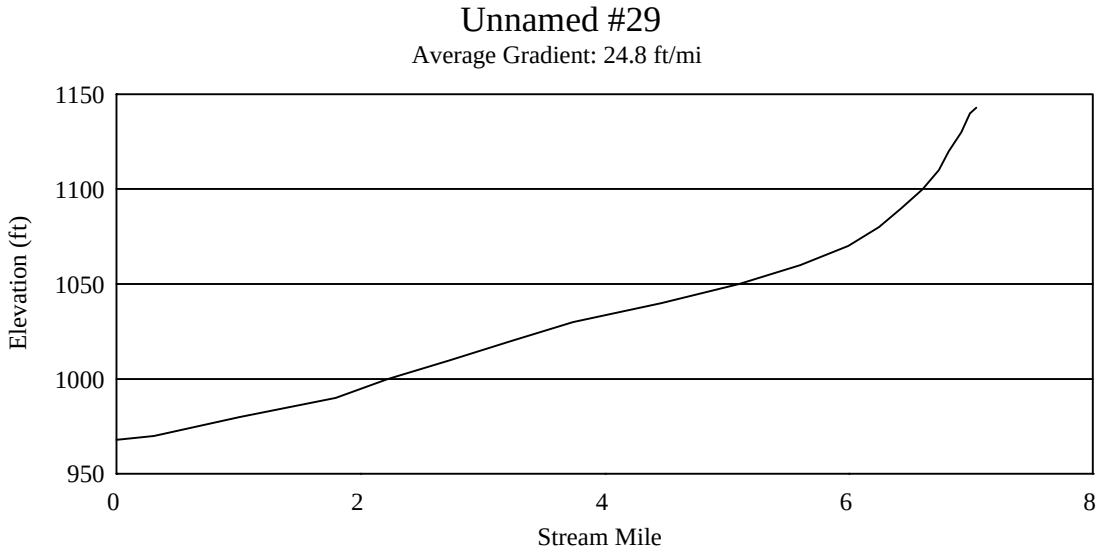
Appendix A. Gradient plot for Mill Creek, a 4th order tributary of the Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 65, Range 37 and Section 17. The stream is located on 7.5 minute quadrangle maps Burlington Junction, Clearmont, and Blanchard.



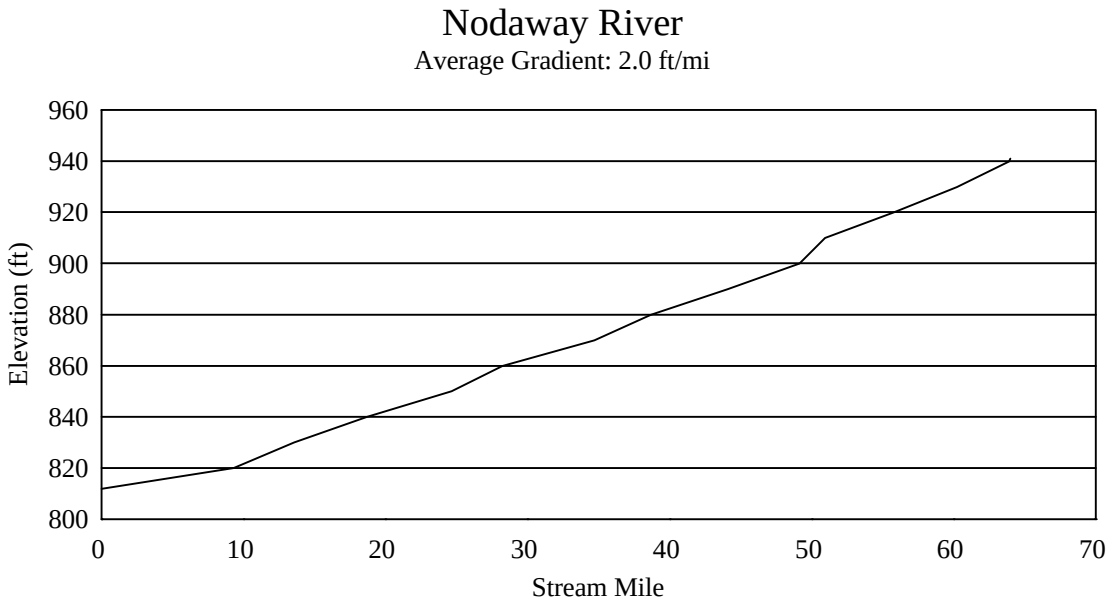
Appendix A. Gradient plot for Unnamed stream number 8, a 4th order tributary of Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 61, Range 37 and Section 27. The stream is located on 7.5 minute quadrangle maps New Point, and Fillmore.



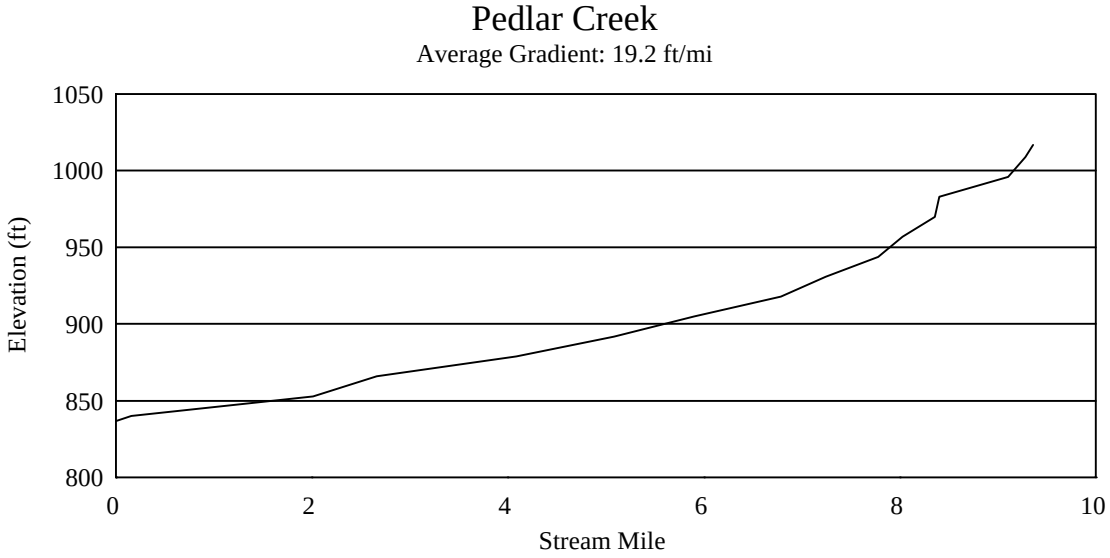
Appendix A. Gradient plot for Unnamed stream number 24, a 4th order tributary of South Fork Clear Creek in the Nodaway River watershed. The location of the mouth is at Township 65, Range 36 and Section 17. The stream is located on 7.5 minute quadrangle map Wilcox.



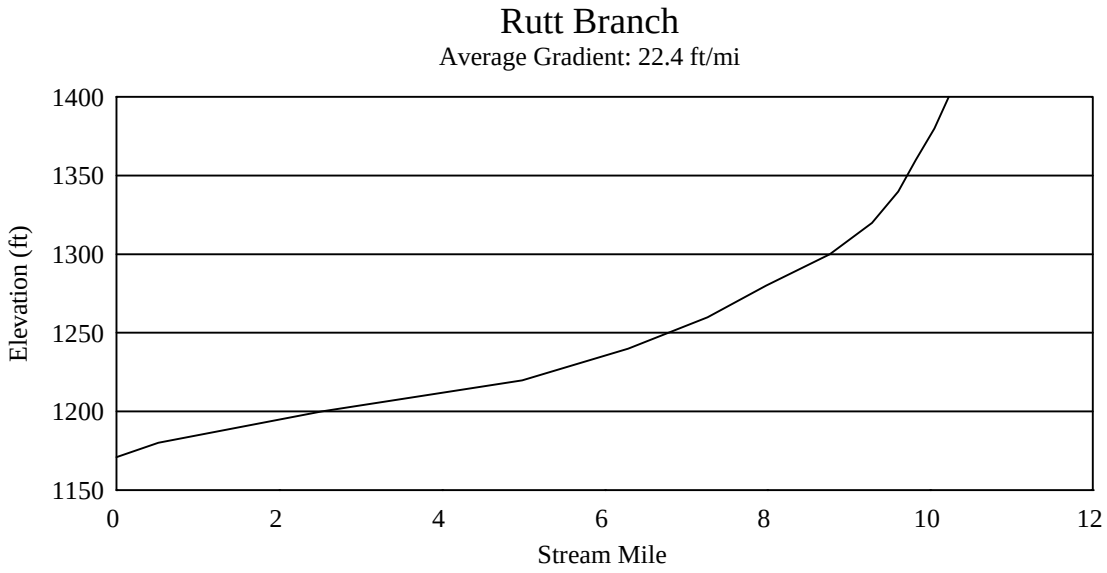
Appendix A. Gradient plot for Unnamed stream number 29, a 4th order tributary of Clear Creek in the Nodaway River watershed. The location of the mouth is at Township 66, Range 36 and Section 22. The stream is located on 7.5 minute quadrangle map Hopkins SW.



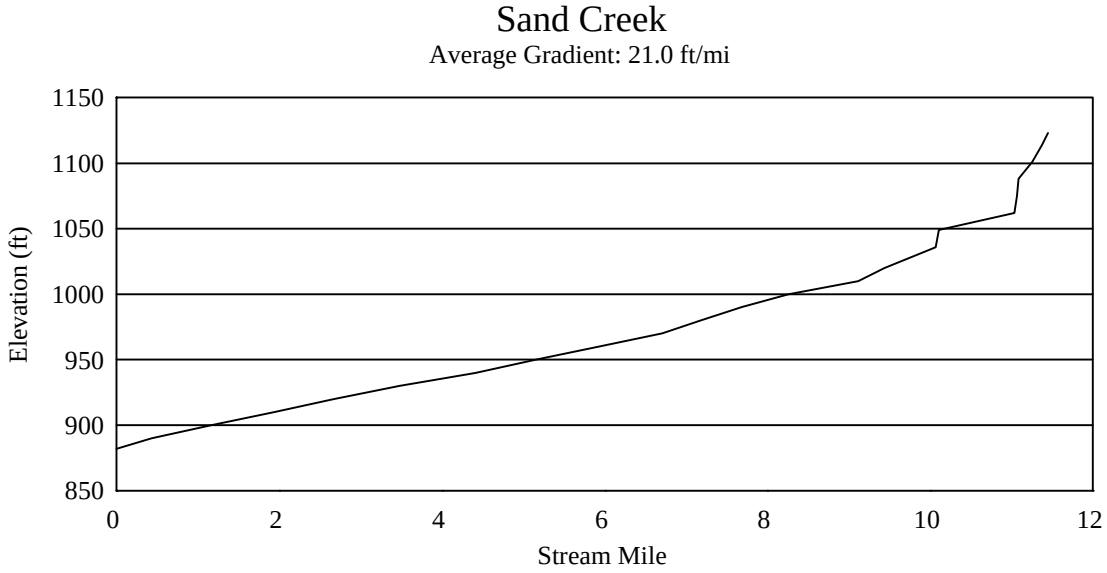
Appendix A. Gradient plot for the Nodaway River, a 6th order tributary of the Missouri River. The location of the mouth is at Township 59, Range 36 and Section 29. The stream is located on 7.5 minute quadrangle maps Amazonia, Forbes, New Point, Maitland, Skidmore, Burlington Junction, Clearmont, and Clarinda South.



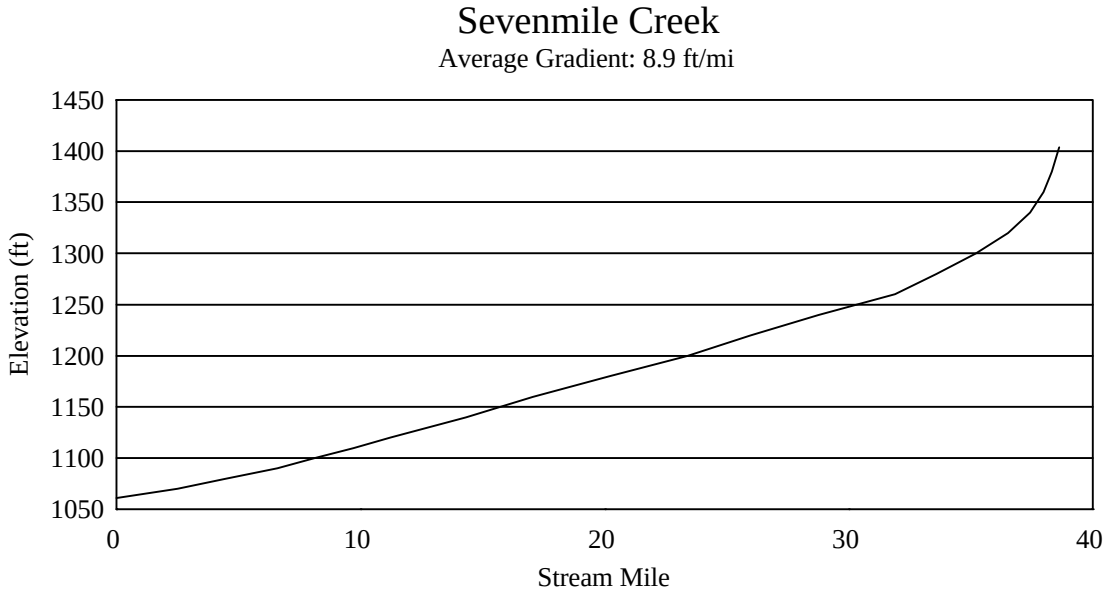
Appendix A. Gradient plot for Pedlar Creek, a 4th order tributary of Arapahoe Creek in the Nodaway River watershed. The location of the mouth is at Township 61, Range 36 and Section 30. The stream is located on 7.5 minute quadrangle maps New Point, Fillmore, and Bolckow.



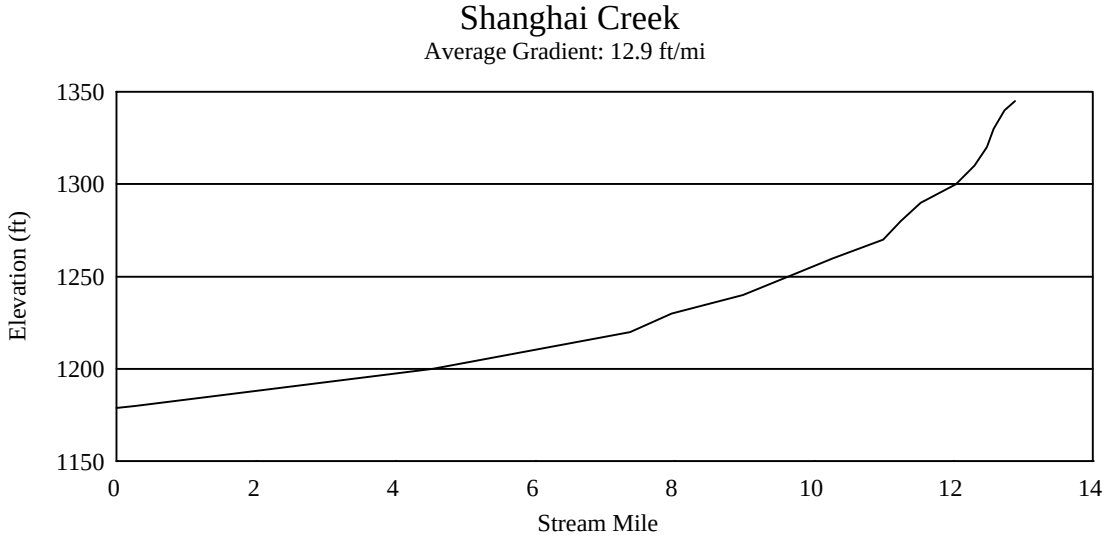
Appendix A. Gradient plot for Rutt Branch, a 4th order tributary of West Fork of the Middle Nodaway River, in the Nodaway River watershed. The location of the mouth is at Township 75, Range 33 and Section 15. The stream is located on 7.5 minute quadrangle maps Fontanelle SW, Fontanelle, and Canby.



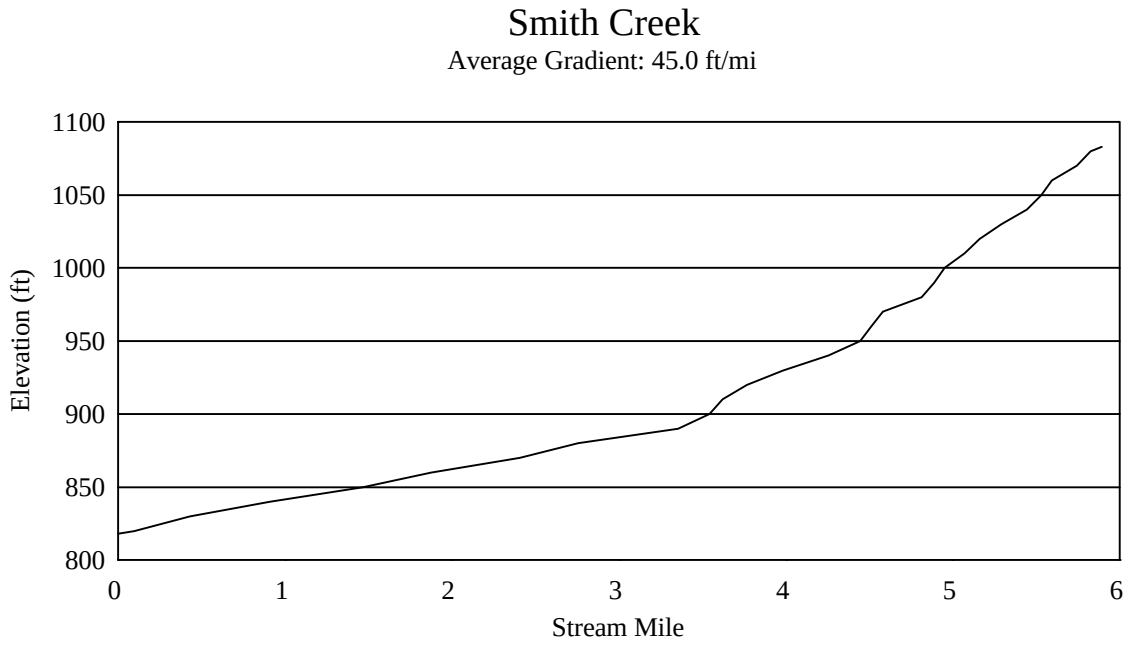
Appendix A. Gradient plot for Sand Creek, a 4th order tributary of the Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 64, Range 37 and Section 21. The stream is located on 7.5 minute quadrangle maps Skidmore, Burlington Junction, and Wilcox.



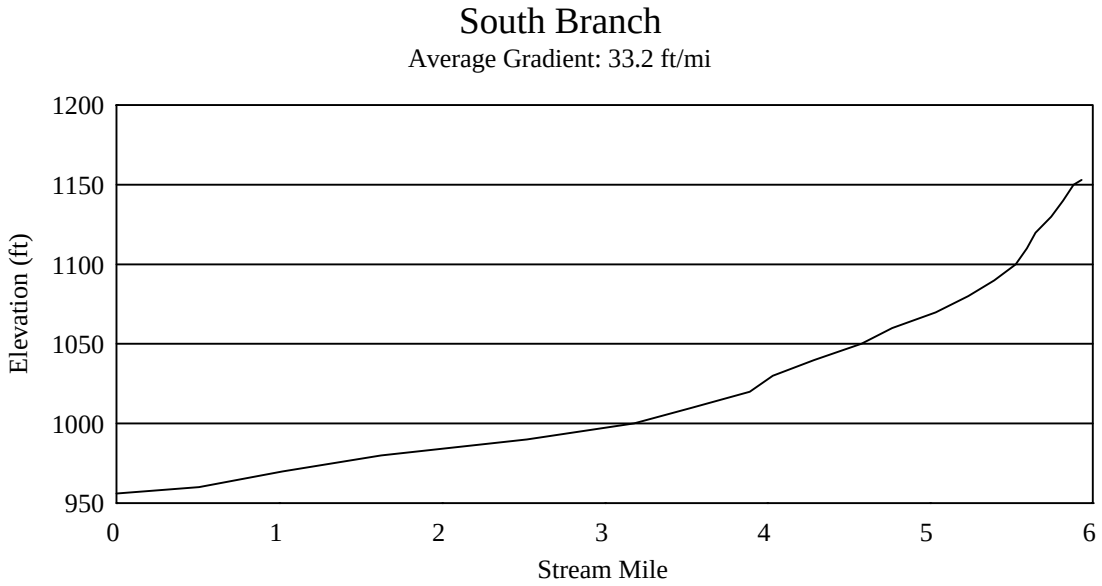
Appendix A. Gradient plot for Sevenmile Creek, a 4th order tributary of the West Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 73, Range 36 and Section 33. The stream is located on 7.5 minute quadrangle maps Morton Mills, Wallin, Griswold NE, Lewis, Anita SW, Grant, Massena, Fontanelle SW, and Adair South.



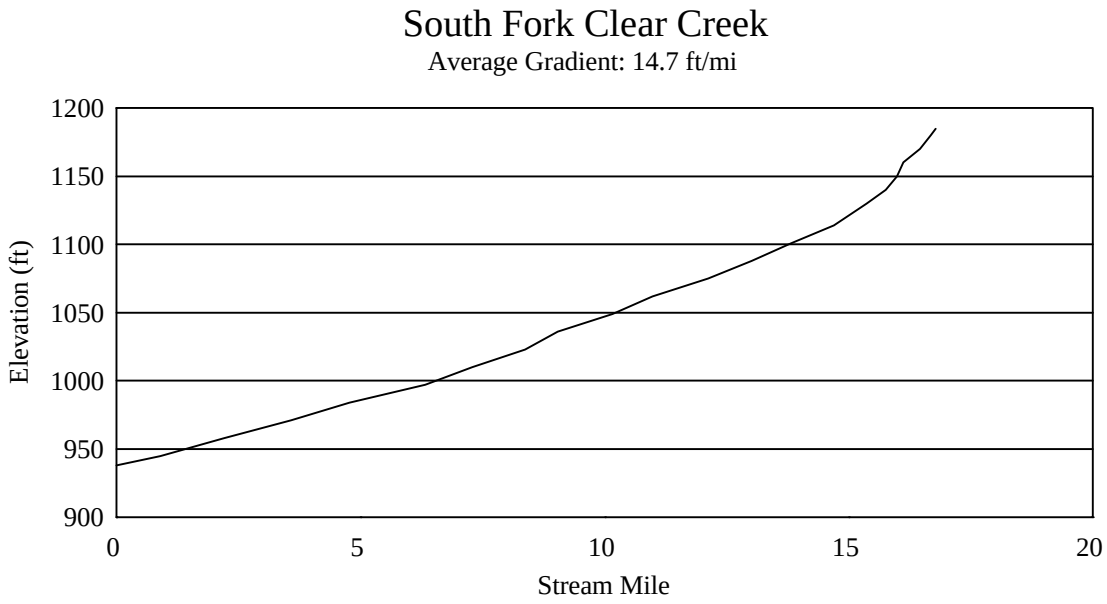
Appendix A. Gradient plot for Shanghai Creek, a 4th order tributary of East Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 73, Range 32 and Section 16. The stream is located on 7.5 minute quadrangle maps Prescott, Nevinville, and Orient.



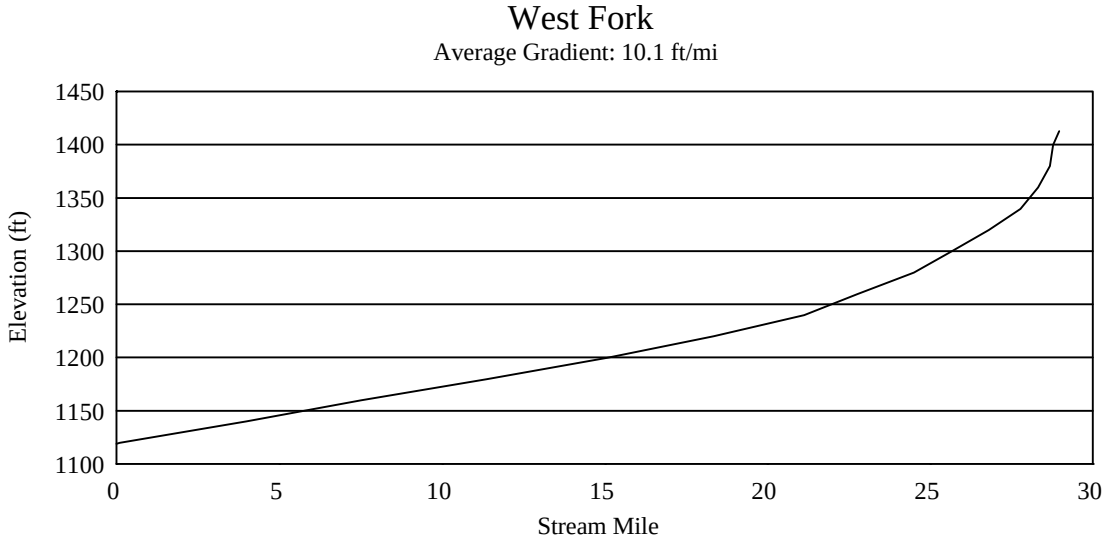
Appendix A. Gradient plot for Smith Creek, a 4th order tributary of the Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 59, Range 36 and Section 07. The stream is located on 7.5 minute quadrangle maps Amazonia, and Forbes.



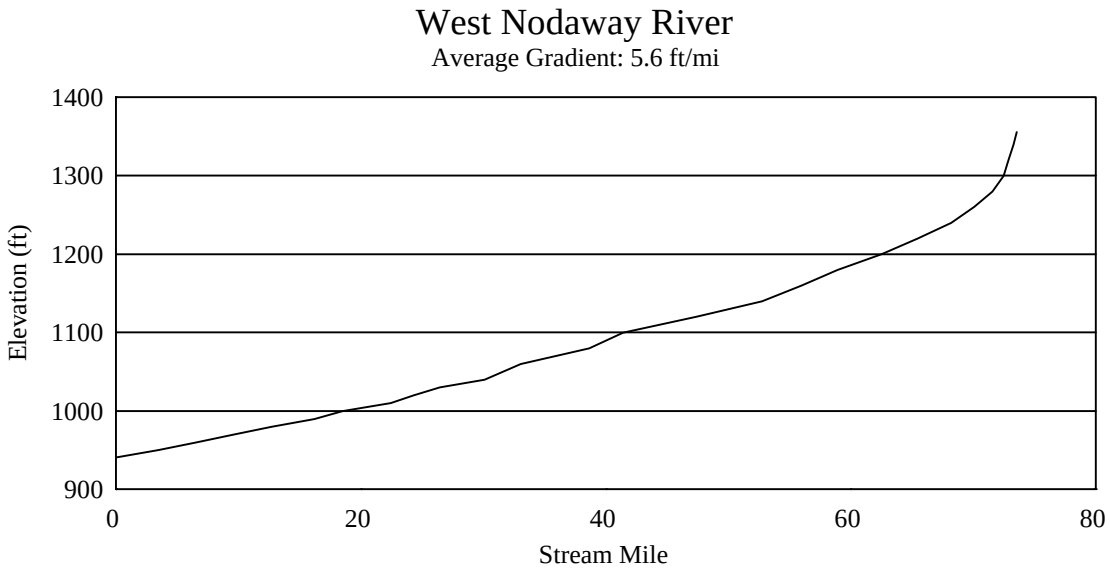
Appendix A. Gradient plot for South Branch, a 4th order tributary of the West Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 68, Range 36 and Section 18. The stream is located on 7.5 minute quadrangle map Clarinda South.



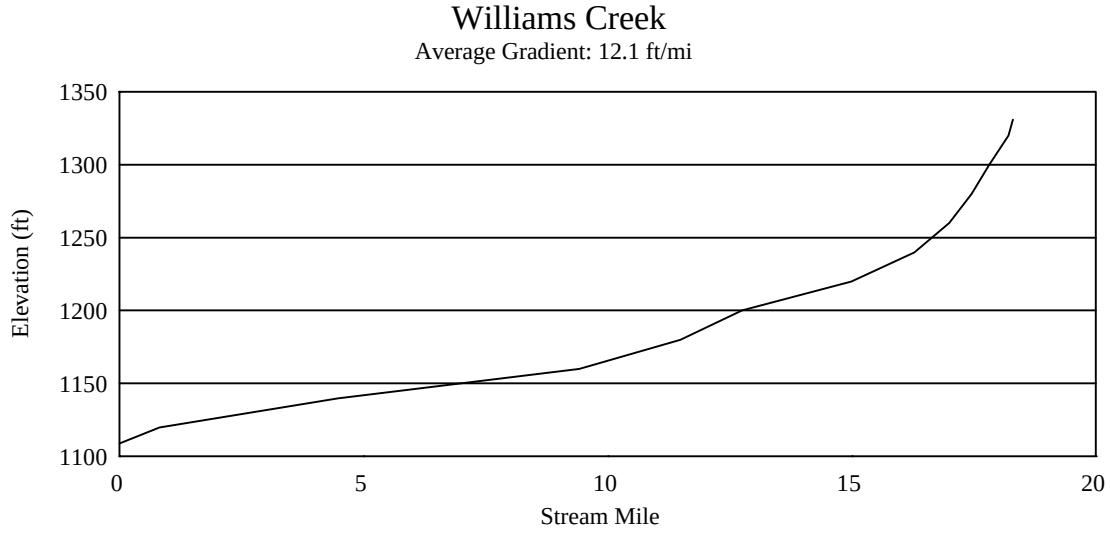
Appendix A. Gradient plot for South Fork Clear Creek, a 4th order tributary of Clear Creek in the Nodaway River watershed. The location of the mouth is at Township 66, Range 36 and Section 29. The stream is located on 7.5 minute quadrangle maps Wilcox, and Hopkins SW.



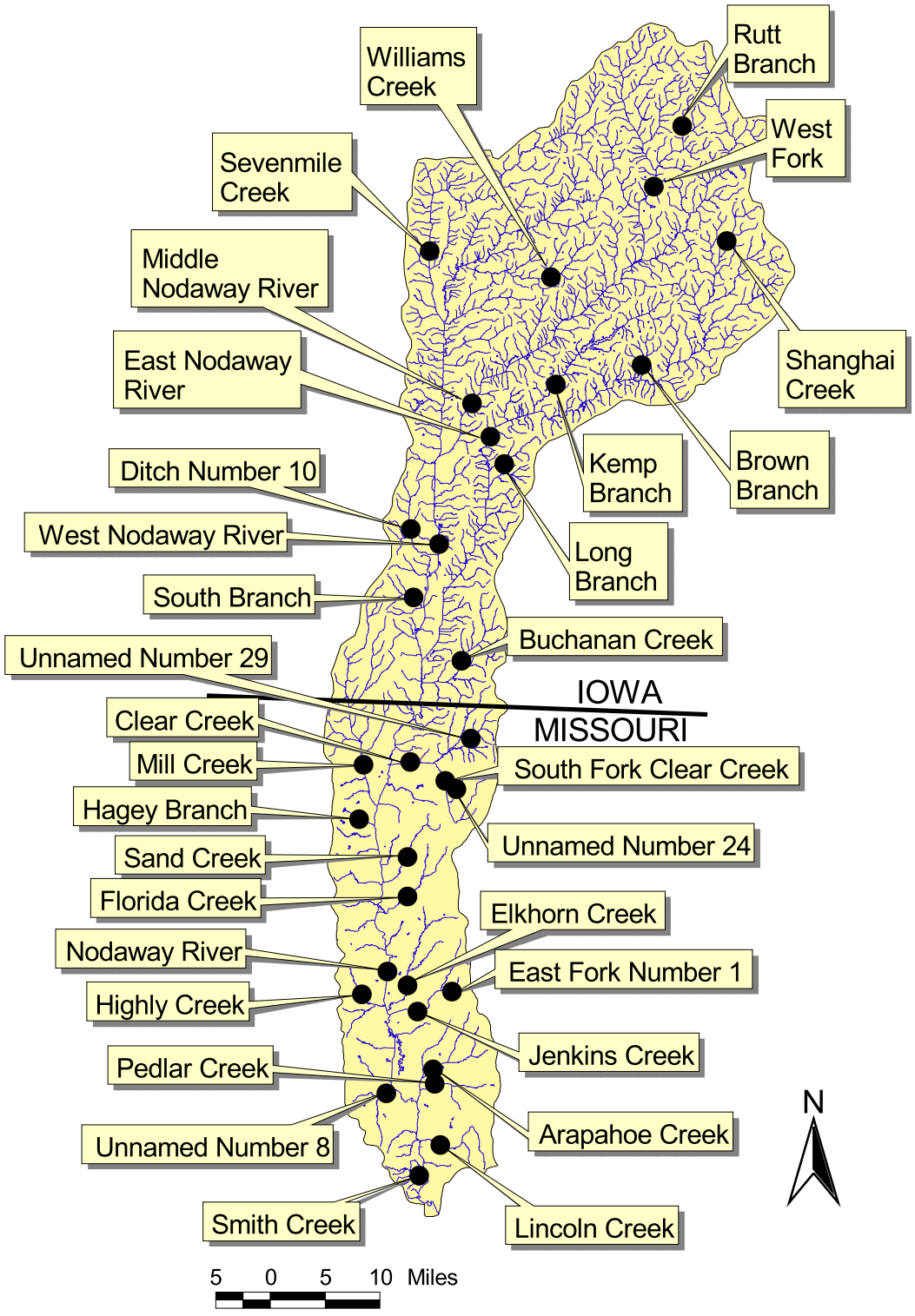
Appendix A. Gradient plot for West Fork, a 5th order tributary of the Middle Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 74, Range 33 and Section 33. The stream is located on 7.5 minute quadrangle maps Bridgewater, Fontanelle SW, Adair South, and Canby.



Appendix A. Gradient plot for West Nodaway River, a 6th order tributary of the Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 67, Range 36 and Section 07. The stream is located on 7.5 minute quadrangle maps Clarinda South, Clarinda North, Hawleyville, Stanton, Villisca, Morton Mills, Grant, Dewey, Massena, Bridgewater, and Fontanelle SW.



Appendix A. Gradient plot for Williams Creek, a 4th order tributary of the West Nodaway River in the Nodaway River watershed. The location of the mouth is at Township 74, Range 36 and Section 35. The stream is located on 7.5 minute quadrangle maps Grant, Dewey, and Bridgewater.



Appendix A. Location of streams for which the gradient plots were generated. Gradient plots for 4th order and larger streams within the Nodaway River watershed, digitized from 7.5 minute series, 1:24000 scale, USGS topographic maps. Maps are on the following pages.

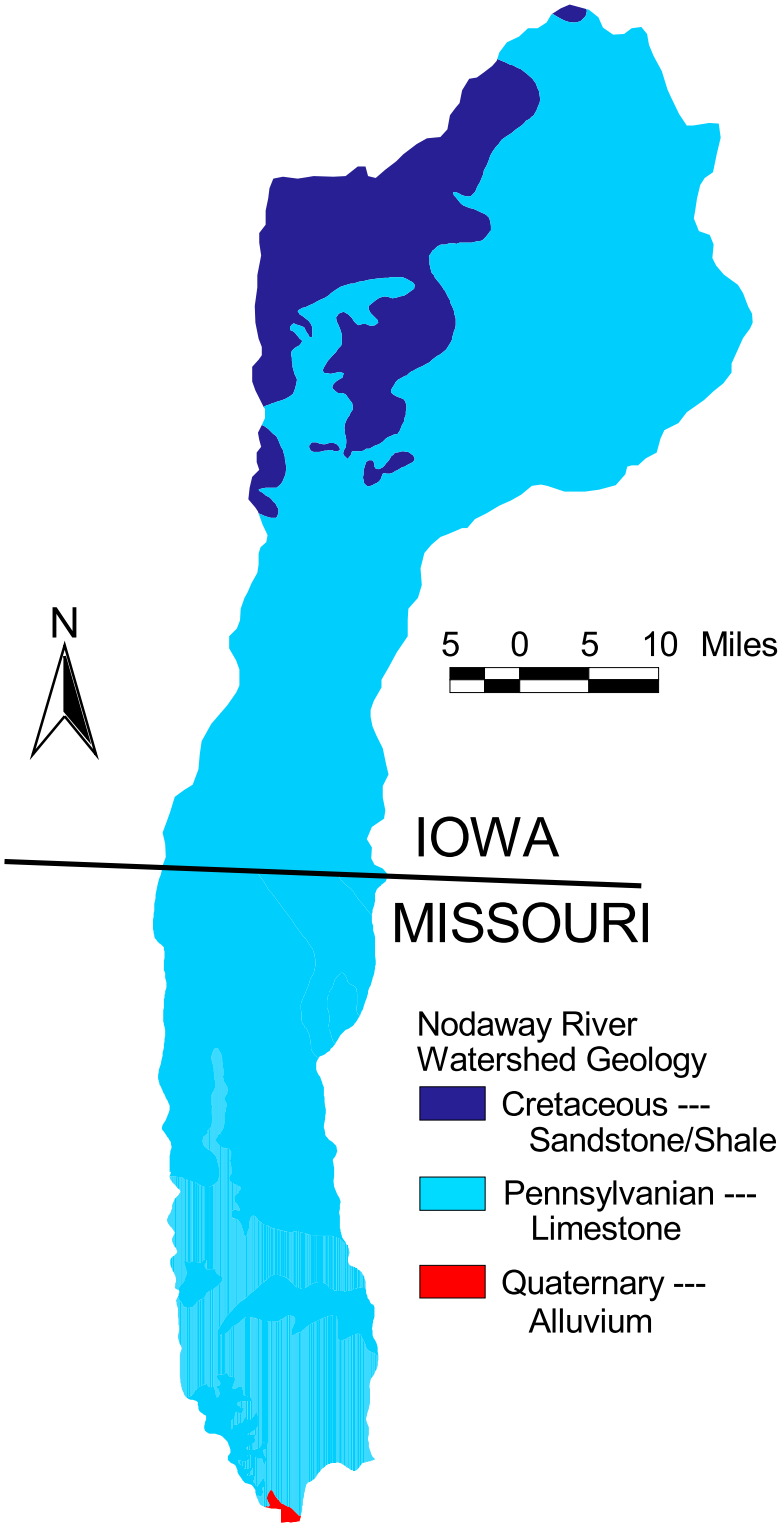


Figure GE. Geology in the Nodaway River watershed in Missouri and Iowa.

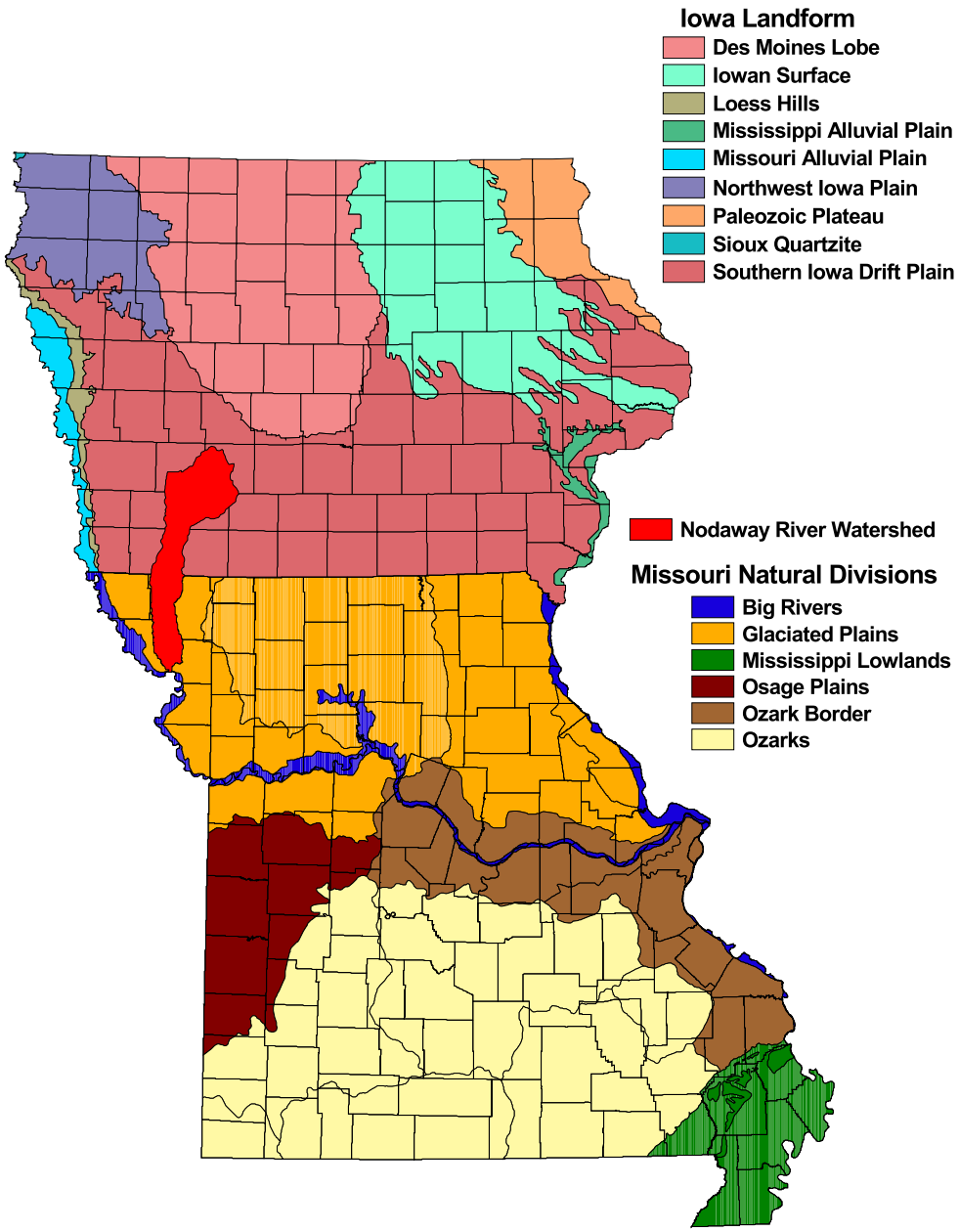


Figure ND. Location of the Nodaway River watershed within the natural divisions of Missouri and the landforms of Iowa.

LAND USE

HISTORIC AND RECENT LAND USE

Prairies dominated the landscape of the Nodaway River basin prior to settlement. Small areas of upland timber were restricted to deep narrow ravines. The timber was often found only in isolated pockets at the upper end of the ravines. Common prairie species included Indian grass, big and little bluestem, buffalo grass, blue and hairy grama, and switch grass. Forest species included elm, ash, and cottonwood along streams and oak-hickory forest types on the uplands (USDA-SCS 1982). Conservative estimates indicate 80% of Nodaway County and 50% of Holt and Andrew counties were once dominated by prairie species (Schroeder 1982). The majority of the basin in Iowa was historically covered by prairie grassland (USDA 1981). A county map from the 1850's for Page County, Iowa indicated a timbered corridor existed along streams of the Nodaway River basin (Varland 1984). Settlement and modification for agricultural production by man has eliminated most of these historic habitats in the Nodaway River basin.

The Nodaway River has been frequented by people for several thousand years, as chronicled by numerous archaeological sites and discoveries in the basin. Fox, Otoe, Ioway, Missouri, Pottawattamie, and Sioux were the Native American inhabitants of the basin. Settlers begin moving to the region in the 1830's. Most were from the eastern states of Kentucky, Tennessee, Georgia, Virginia, Ohio, and Indiana. The Missouri portion of the basin was at one time known as the "Platte Territory" and was acquired by the State of Missouri in the "Platte Purchase" of 1836. Most Native Americans that remained in the area were paid cash for rights to their land and were displaced to land southwest of the Missouri River in what was then the Kansas Territory.

The word "Nadowa" and similar sounding terms are found in many Indian languages. The Algonquian tribes use of the name was applied to mean "utter detestation" usually in reference to bitter enemies. The Menominee, Chippewa, and Ottawa all have terms similar to "Nadowa" that refer to snakes, usually rattlesnakes. "Nadowe" was used by Siouan tribes indicating or in reference to enemies, chiefly Iowa and Teton. The term was often associated with snakes generally thought to be massasauga rattlesnakes (Hodge 1912). The application of the name to the Nodaway River is believed to have described it as being twisted or sinuous like a snake. In the past the name may have been an apt description but the present day Nodaway River resembles a straight ditch more than a snake-like meandering river.

The Lewis and Clark expedition camped near and mentioned the "Nodawa River" and "Little Nodawa and Great Nodawa" islands in the journal of their expedition. They camped on the north shore of the Missouri River near the head of "Nodawa Island" on July 8, 1804. On their return journey they hunted near the Nodaway River and passed by on September 11, 1806 (Biddle 1962).

Settlement first took place in forested areas, and the adjoining prairies were used as free range for cattle. These lands had an important role in the development of the early Missouri cattle industry. Preferred sites were those on the edge of the timber with close association to both water and native prairie. The settlement of prairies soon followed the settlement of forested lands.

Settlement of wet prairies was avoided due to their reputation for producing fevers and respiratory ailments, but they were used as wintering areas for cattle. Native grasses were also cut for hay (Schroeder 1982).

The arrival of more people and cattle, along with the arrival of commercialized farming, marked the beginning of the end for native prairies in the basin. Destruction of the native prairie can be attributed to three main factors: plowing, overgrazing, and fire control (Schroeder 1982).

Cultivation began in the woodland soils along the streams but soon moved to adjoining prairies, as people realized these soils produced better and more plentiful crops. Intense cultivation soon followed on these lands and continued until nearly all lands were converted to agriculture (Schroeder 1982). The first railroads came to the basin in the 1870's. This allowed easy access to better tools for farming and provided for transportation of goods to large city markets. The last areas cultivated were the wet bottom lands. Building ditches and draining these areas helped convert them to agricultural production. Groups of farmers began stream channelization in the early 1900's, and a large part of the Nodaway basin was channelized by the 1930's (USCOE 1973, USDA 1981). This increased the amount of tillable acreage, intensified erosion, and permanently altered the natural quality of the basin's aquatic resources (Kramer 1993).

Overgrazing was also responsible for the destruction of large amounts of native prairie. Native species could not tolerate the intensive grazing and were replaced by introduced species (Schroeder 1982). The practice of fire control contributed to the change in composition of native prairies and eventual domination by invading woody species. Fires, which historically had burned uncontrolled, were important in keeping prairie habitats free of colonizing woody species. The controlling of fires, mainly for safety reasons, allowed woody species to invade. To most settlers of the time, this was viewed as a positive change (Kramer 1993).

The fertile soils and favorable climate of the basin make it an outstanding grain producing area. The majority of basin lands are in cultivation. Land use (Figure lu) in the Nodaway River basin during the early 1980's was 70 % agricultural cropland, 17 % pasture land, six percent forest, and seven percent other uses (USDA-SCS 1982; Table 1). Eighty-five percent of the basin was in row crops or pasture in 1995 (MDNR 1995). Since the 1970's, cropland acreage has increased, while set aside land, pasture, and forest lands have decreased. Eighty-seven percent of the bottom land was in row crop agriculture in 1982. Projected land use pattern changes were for more upland conversion to row crop agriculture, with a concurrent increase in erosion and flooding (USDA-SCS 1982). This could cause lower water quality and increased habitat degradation in the Nodaway River basin.

Forest resources are of minor importance to landowners in this agricultural row crop oriented basin. Existing forested lands are generally in poor condition. Most of the forest is found in fence rows, narrow riparian corridors, and areas of terrain that cannot be cultivated. Most trees remain on the poorest soils and have growth rates that are far below those expected from intensively managed stands. More than half of the basin's forested lands are grazed. Overgrazing deteriorates the forest floor, resulting in much higher than normal erosion. In extreme cases it can cause destruction of forest blocks (USDA-SCS 1982).

Table 1. Land use estimates from Conservation Needs Inventory data (USDA 1982).

	Cropland	Pasture	Forest	Other	Urban	Federal	Water
Total Acres	817,660	195,760	64,840	41,300	40,100	1,500	3,640
Total (%)	70	17	6	4	3	0	0
Iowa Total (%)	49	13	2	2	2	0	0
Missouri Total (%)	21	4	4	2	1	0	0
Iowa Total (%)*	73	19	2	3	3	0	0
Missouri Total (%)*	65	13	13	6	3	0	0
Bottom land Total (%)	87	4	7	2	0	0	0

*percents indicate total for each within that states portion of the basin.

SOIL CONSERVATION PROJECTS

The Nodaway River basin is in the second most erosive area in the United States (USDA-SCS 1983). Because of intense erosion problems in the Platte territory area (includes the Nodaway River basin), the United States Department of Agriculture (USDA) targeted the area in the mid 1980's with programs to reduce erosion, increase productivity, and help the income of farmers in the area (USDA-SCS 1983). Emphasis was placed on conservation tillage, and in particular no-till cultivation. There are several conservation programs, both state and federally sponsored, that provide technical and/or financial assistance to land owners in the basin.

Two available programs in the Missouri portion of the basin are Special Area Land Treatment (SALT) and EARTH projects, sponsored by the Missouri Department of Natural Resources (MDNR). These programs are coordinated through local Soil and Water Conservation Districts (SWCD) and make resources available for land owners in each target watershed. There are no EARTH projects in the basin at this time.

SALT projects focus on particular watersheds, that through land owner cooperation, strive to improve soil conservation. The SALT programs use total resource management planning to treat land so that all its resources are used effectively, while being protected from excessive soil erosion. Other goals of the program include: improved water quality and reduced sedimentation; increased use of conservation oriented agricultural practices; improved grassland establishment; better management of animal waste; increased timberland productivity; and improved wildlife habitat. Current SALT projects in the basin and their status are found in Table 2.

Watershed Protection and Flood Prevention Act (Public Law 83-566) watershed projects are federally funded and have been common practices in the Nodaway River basin (Table 3). The act authorizes the USDA through the Natural Resources Conservation Service (NRCS) to assist local

Table 2. Status of Special Area Land Treatment (SALT) projects within the Nodaway River basin (Missouri) as of April 1997.

Natural Resources Conservation Service District	Project Name	Watershed Acres	Acres Needing Treatment	Completion Date
Holt	Hickory Creek	5,900	Unknown	Fiscal 1999
Holt	Nichols Creek	4,338	2,927	Fiscal 1997
Andrew	Lower Pedlar Creek	3,989	1,933	Fiscal 1995
Andrew	Upper Lincoln Creek	7,835	3,981	Fiscal 1995
Nodaway	East Branch Elkhorn Creek	5,340	3,450	Fiscal 1999
Nodaway	Jenkins Creek	5,400	3,824	Fiscal 1995
Nodaway	East Branch Jenkins Creek	3,784	1,709	Fiscal 1999

Table 3. Information on PL 83-566 watershed projects in the Nodaway River basin as of January 1997. (USDA-SCS 1991, USDA-NRCS 1997)

Watershed	Acres	Status
Hoover-Frankum (MO)	18,307	completed October 1975
Mill Creek (IA/MO)	25,500	approved July 1989
Clear, Cayhoga, and Muddy Creek (MO)	74,320	currently inactive application
A & T Long Branch (IA)	16,362	operations stage
Hacklebarney (IA)	44,850	operations stage
West Douglas (IA)	6,370	completed 1969
Show Creek (IA)	14,245	application awaiting action
Walter's Creek (IA)	31,560	completed 1979
West Nodaway (IA)	101,125	application awaiting action

organizations in planning and installing watershed projects. The act uses a multi-purpose approach in solving water and land related resource problems including flood prevention, agricultural water management, water supply, recreation, and fish and wildlife development. There are three completed (PL 83-566) watershed protection projects, two under construction,

and one approved for construction, in the Nodaway River watershed (Table 3).

The Wetland Reserve Program (WRP) was authorized in 1990 and started enrolling land owners periodically in 1992. The WRP allows owners of eligible land to offer an easement for purchase and receive cost-share assistance in restoring wetlands. The benefits generated by this program include: reduced soil erosion; collection of sediments; flood water retention; improved water quality; ground water recharge; and improved fish and wildlife habitat. Eligibility requirements include: farmed wetlands; previously converted wetlands; existing wetlands; and those adjacent lands deemed necessary to protect restored areas. More information is available through local NRCS offices.

The Conservation Reserve Program (CRP) is a federally funded program in place to protect and enhance soil conservation, water quality, and fish and wildlife habitats. Land eligible for sign up includes cropland, marginal pasture, former CRP lands, and field margins including riparian corridors. More information is available through local NRCS offices.

PUBLIC AREAS

There are 15,759 acres (1% of watershed total) of public land in the Nodaway River basin. Table 4 contains specific information for public areas in the Missouri (Figure mp) portion of the basin and Table 5 gives Iowa (Figure ip) information. All of the Nodaway River basin public lands in Missouri (10,730 acres; Table 4) are managed by the Missouri Department of Conservation (MDC). Areas range from intensively managed wetland areas and fishing lakes to moderately managed upland and natural areas with both consumptive and non-consumptive uses. The Iowa public lands are managed by various county conservation boards, municipalities, and state agencies.

There are six stream access sites in the Missouri portion of the basin. The sites are all located on the mainstem Nodaway River and offer bank fishing and non-improved boat access. Three additional river accesses have been proposed in the MDC's stream acquisition plan (McPherson 1994). A site in Andrew County approximately seven miles northwest of Fillmore, Missouri was rated as a high priority acquisition. Two other sites in Nodaway County, Missouri (1/2 mile southwest of Skidmore and 1/2 mile west of Quitman) were rated as medium priority acquisitions. These new sites would offer boat access and bank fishing on the mainstem Nodaway River. Iowa has two stream access sites, one on West Nodaway Wildlife Area (West Nodaway River), and the other near Braddyville(Nodaway River) (Table 5).

Within the basin there are 38 public fishing impoundments in Missouri and eleven public areas with fishable waters in Iowa (Table 5). The largest lake in the basin is Lake Icaria in Iowa. This 700-acre reservoir on Kemp Creek (a tributary of the East Nodaway River) in Adams County has concrete boat ramps, a swimming beach, fishing jetties, a marina, and camping facilities. Viking Lake is a 137 acre lake on Dunns Creek (a tributary of the West Nodaway River) with facilities for boating, swimming, picnicking, and camping. Bilby Ranch Lake, the largest public impoundment in the Missouri portion of the basin, is 110-acres, has a concrete boat ramp, disabled user accessible restrooms, and a floating fishing dock. The MDC's Public Lakes Program Acquisition and Development Plan (Ryck 1991) lists Honey Creek Conservation Area

(CA) as medium priority and Monkey Mountain CA as low priority to receive additional lake and pond construction.

Table 4. Nodaway River basin public lands in Missouri.

Area Name	Acres	Description	Stream Frontage	County
Monkey Mountain CA	787 total	hiking trails, hunting, fishing primitive camping, river access	Nodaway River	Holt
Nodaway Valley CA	3,752 total 200 wetland 42 fishable	waterfowl hunting and viewing, hunting, fishing, primitive camping, river access	Nodaway River	Andrew Holt
Honey Creek CA	1,148 total	Hiking trails, hunting, fishing, primitive camping, river access	Nodaway River	Andrew
Bilby Ranch Lake CA	5,030 total 150 fishable	hiking trails, hunting, fishing, boat ramp, disabled accessible fishing dock, primitive camping	None	Nodaway
Tom Brown Access	7 total	river access - no boat ramp	Nodaway River	Andrew
Maitland Access	1 total	river access - no boat ramp	Nodaway River	Holt
Possum Walk Access	5 total	river access - no boat ramp	Nodaway River	Nodaway

Table 5. Nodaway River basin public lands in Iowa.

Area Name	Acres	Description	Stream Frontage	County
Adair Wildlife Area	352 total	hunting, wildlife viewing	None	Adair
Greenfield Lake	236 total 44 fishable	fishing, hiking, boat ramp	None	Adair
Highway 92 Wildlife Area	12 total	hunting, wildlife viewing	None	Adair
Ken Sidney Nature Area	107 total	hunting, hiking	None	Adair
Lake Nodaway	80 total 22 fishable	fishing, camping	None	Adair
Lake Orient	86 total 24 fishable	hunting, fishing, camping, boat ramp	None	Adair
Morman Trail Park	170 total 35 fishable	hunting, fishing, camping, swimming boat ramp, shooting range	None	Adair

Area Name	Acres	Description	Stream Frontage	County
Rex Sullivan Wildlife Area	160 total	hunting, wildlife viewing	None	Adair
Nodaway Wildlife Area	40 total 8 fishable	hunting, fishing, wildlife viewing	None	Cass
West Nodaway Wildlife Area	220 total	hunting, fishing, wildlife viewing	West Nodaway River	Cass
Siam Tract	110 total	hunting, wildlife viewing		Taylor
Braddyville Access	6 total	fishing	West Nodaway River	Page
Nodaway Valley Park	165 total	camping, hiking	None	Page
Ross Park	76 total 12 fishable	hunting, fishing, wildlife viewing, camping	None	Page
Stephens Tract Wildlife Area	4 total	wildlife viewing	None	Page
Lake Icaria Recreation Area	1,945 total 700 fishable	hunting, fishing, camping, hiking, swimming, boat ramp	None	Adams
Spring Lake Park	27 total 2 fishable	fishing, wildlife viewing	None	Adams
Erickson Prairie	3 total	native prairie	None	Montgomery
Hacklebarney Woods	230 total 10 fishable	hunting, fishing, camping, hiking, wildlife viewing	None	Montgomery
Viking State Park	1,000 total 137 fishable	fishing, camping, hiking, swimming	None	Montgomery

CORPS OF ENGINEERS 404 JURISDICTION

Most instream and some stream-side projects require 404 permits. Applications for permits should be directed to the appropriate U.S. Army Corps of Engineers office. The Nodaway River basin in Missouri is under the jurisdiction of the Kansas City District while the Iowa portion of the basin is managed by the Rock Island District.

Missouri: 700 Federal Building, Kansas City, MO 64106-2896, Attn: MRKOD-P, (816)426-5357

Iowa: Clock Tower Building, Rock Island, IL 61201-2004, Attn: NCROD-S, (309)788-6361 ext.6370

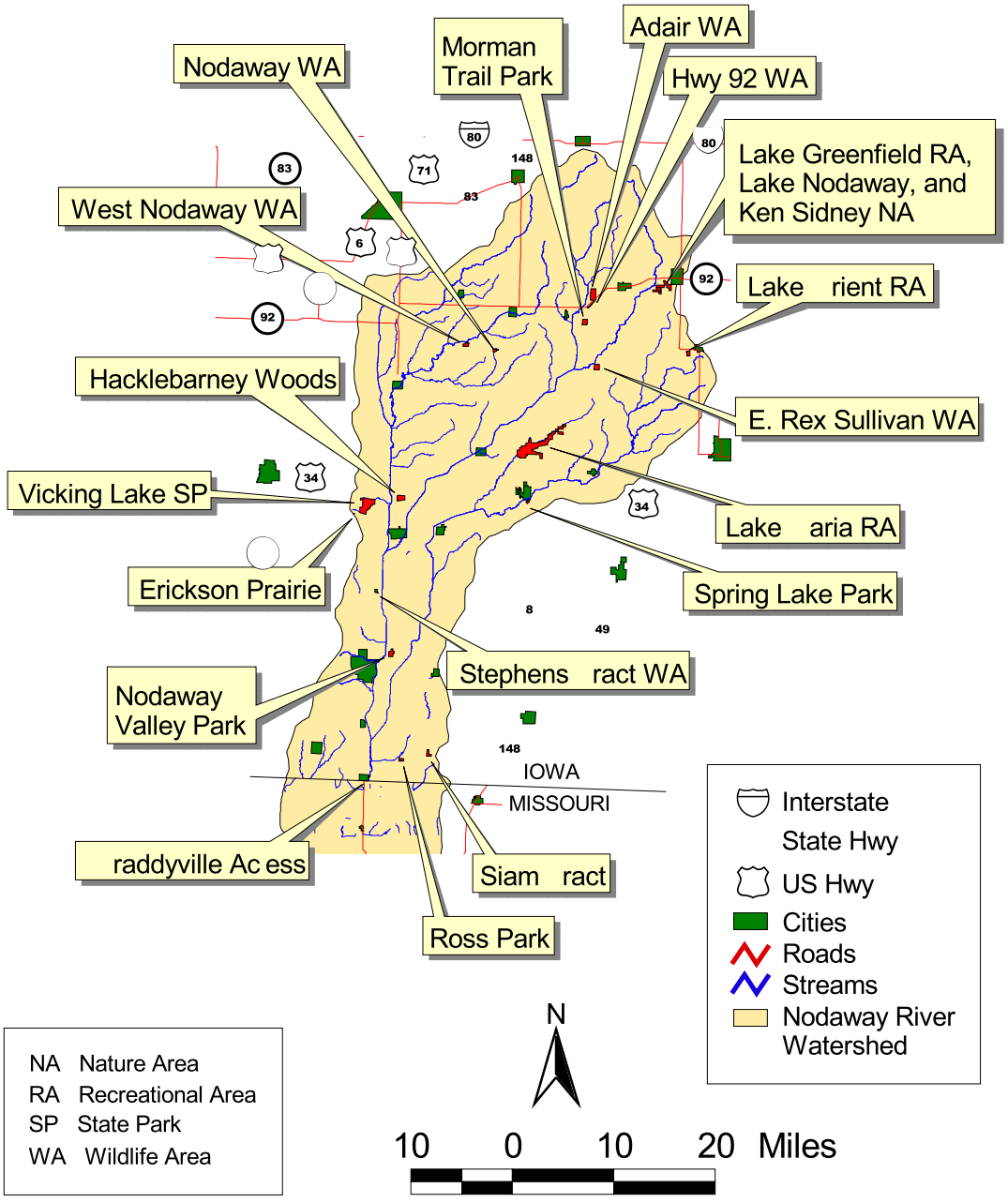


Figure ip. Location of publically owned land in the Iowa portion of the Nodaway River watershed.

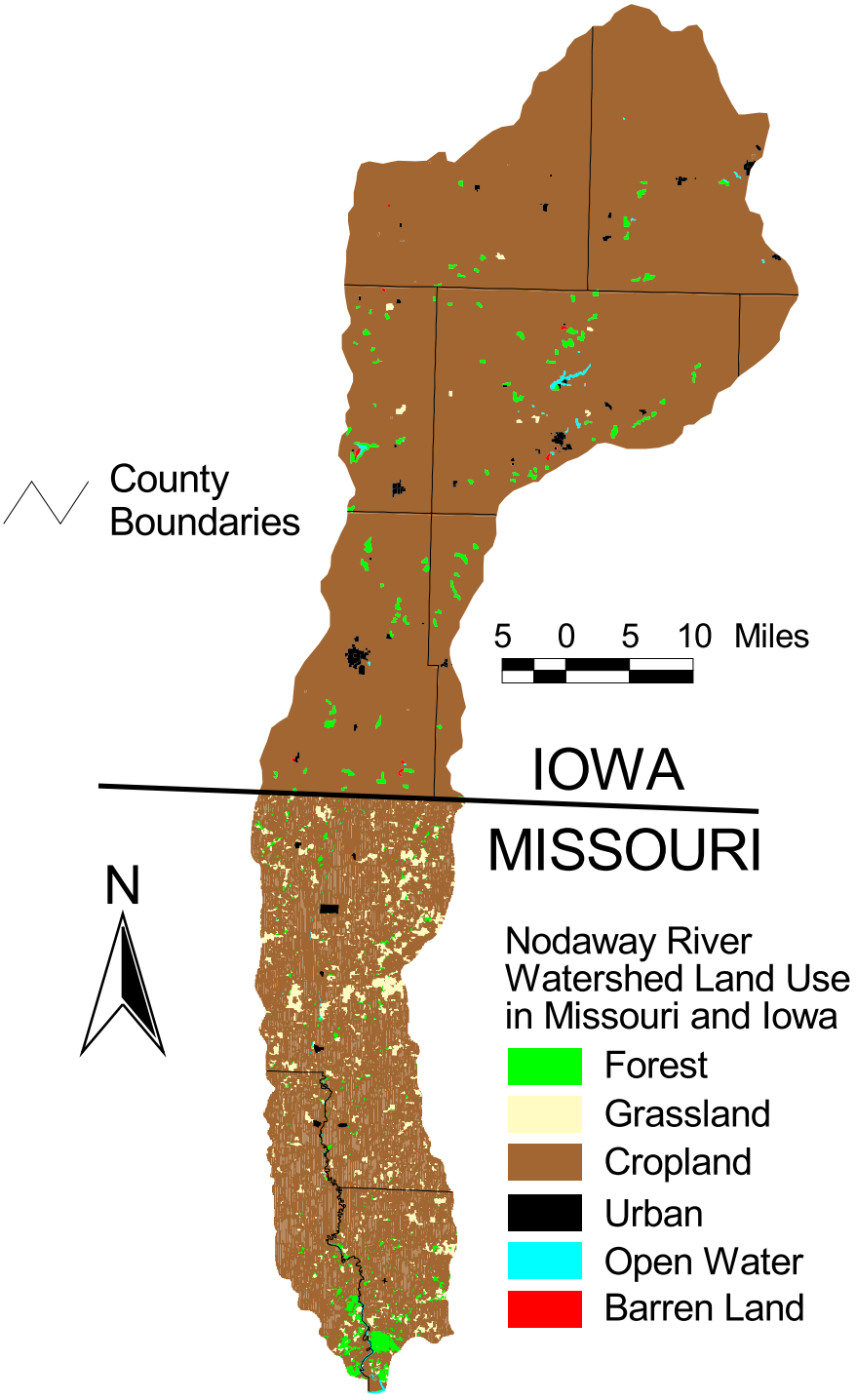


Figure lu. Land use/cover in the Nodaway River watershed (MORAP 1999, preliminary data).

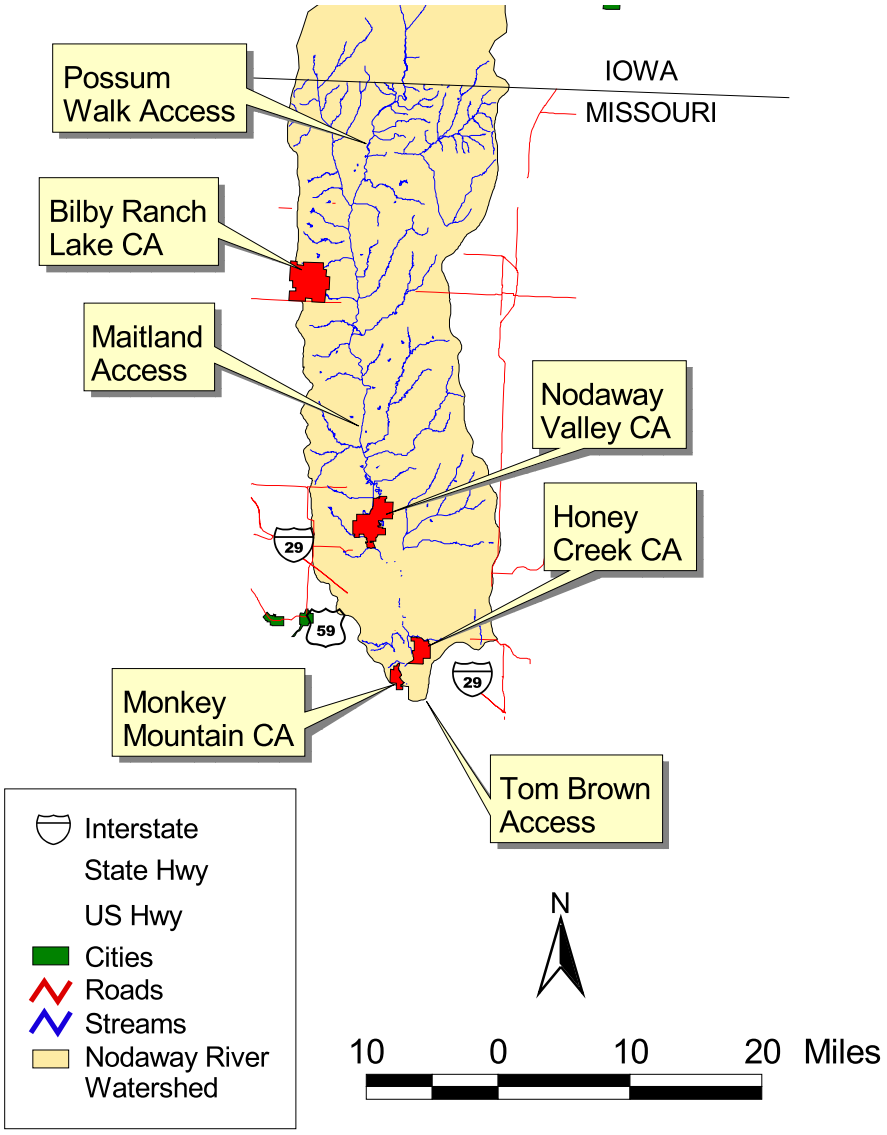


Figure mp. Location of publically owned land in the Missouri portion of the Nodaway River watershed. The abbreviation CA represents Conservation Area.

HYDROLOGY

PRECIPITATION

The average annual precipitation in the basin ranges from 31 inches in the northern part to 35 inches in the southern part (about 90 % in the form of rainfall, USDA 1981). About 70 % of the rainfall occurs in the 150-180 day growing season (USCOE 1973). Average annual snowfall ranges from 20 to 30 inches across the basin, increasing from south to north (USDA 1981, MDNR 1986b). Runoff ranges from four to six inches annually. Certain factors influence runoff severity such as soil erodibility, soil permeability, soil saturation, land cover, and the time-span over which the runoff occurs (MDNR 1986b). Runoff and discharge are primarily driven by rainfall (Figure 2; data from Graham, Missouri gauging station). Discrepancies in discharge, as a function of precipitation for Figure 2, were probably caused by snowmelt in February and localized heavy rainfall in the upper portion of the basin in June. The basin in Missouri is in the driest part of the state, and due to highly variable annual precipitation has been subject to extensive dry periods.

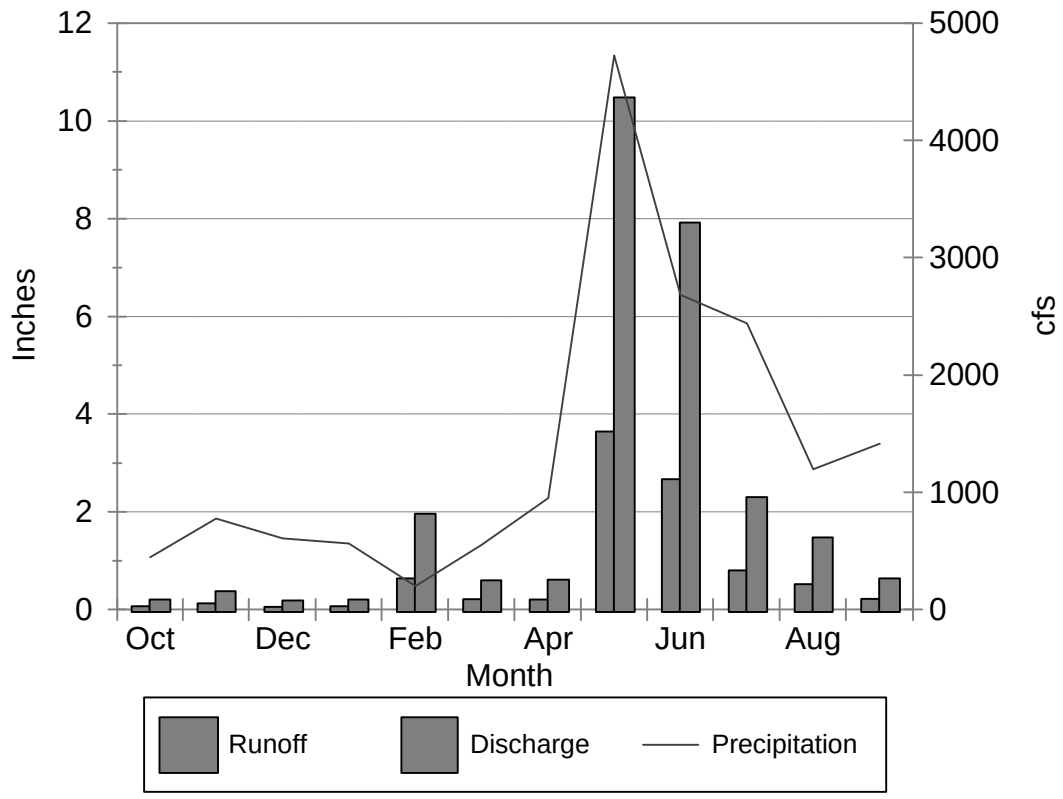


Figure 2. Discharge (cfs), precipitation (inches), and runoff (inches), for water year October

1995 through September 1996 (USGS 1997, NOAA website 1997).

GAUGING STATIONS

There are two active United States Geological Survey (USGS) gauging stations (Figure ga) and one active partial records gauging station in the Nodaway River basin. The three stations are all located on the mainstem Nodaway River near the towns of Graham, Missouri, Clarinda, Iowa, and Massena, Iowa (USGS 1995a, USGS 1996a). Inactive gauge stations are located near Villisca, Iowa, Burlington Junction, Missouri, and Oregon, Missouri. A complete listing of locations and details for all six can be found in Table 6.

Table 6. Gauging stations located in the Nodaway River basin (USGS 1995a, USGS 1996a).

Station Number	Location (Township - Range - Section)	UTM Coordinates	Watershed Area (Mi.^{2})	Type	Record Period
06817700	Graham, MO, Nodaway River (62N-37W-9)	x - 323860 y - 4452000	1,380	D/Q	1982-Present
06817000	Clarinda, IA, Nodaway River (69N-36W-32)	x - 330060 y - 4511580	762	D/Q	1918-1925 1936-Present
06816290	Massena, IA, West Nodaway River (75N-34W- 33)	x - 352660 y - 4567240	23	C	1966-Present
06816500	Villisca, IA, West Nodaway River (71N-36W-28)	x - 332080 y - 4532600	342	D*	1918-1925
06817500	Burlington Junction, MO, Nodaway River (65N-37W-17)	x - 322860 y - 4479080	1,240	D*	1922-1983
06817800	Oregon, MO, Nodaway River (60N-37W-36)	x - 329420 y - 4426280	1,770	D/Q*	1968-1975 1977-1989

Station Type: D = Continuous record stream flow gauging station; C = Crest gauging station; Q = Water quality station; * = Currently inactive.

PERMANENT AND INTERMITTENT STREAMS

There are 156 third order and larger streams in the Nodaway River basin (Appendix B). The permanence/intermittence of particular streams can be determined from 7.5 minute series topographical maps found in the coverage in Appendix C. Permanent streams are indicated with solid blue lines and intermittent streams are indicated with dashed blue lines. The mainstem Nodaway was classified as permanently flowing for 52 of its 61 miles in Missouri (Funk 1968). Based on current USGS 7.5 minute maps there are 485 miles of permanently flowing and 138 miles of intermittently flowing streams and rivers, fourth order or higher, in the Nodaway River basin. Most lower order streams in the basin are intermittent. Increased intermittence, resulting from lower base flows and sedimentation, is occurring throughout the basin.

Appendix B. Stream information for third order and larger streams from the Nodaway River basin obtained from 7.5 minute series, 1:24,000 scale, USGS topographic maps. (Original length and miles channelized for all streams fourth order and larger were estimated using 7.5 minute series, 1:24,000 scale, USGS orthophoto quadrangle maps).

Stream Name	Max. Order	Location at Mouth T R S	Map Numbers[1]	Receiving Stream	Original Length (Mi.)	Current Length (Mi.)	Miles Channel-ized
Nodaway River	6	59-36-29	M8,M7,L7, K7,J7,I7,H7, G7	Missouri River	116.5	64.0	46.7
Smith Creek	4	59-36-07	M8,M7	Nodaway River	7.2	5.9	1.5
Unnamed #01	3	59-37-11	M7	Smith Creek		1.7	
Lincoln Creek	4	60-37-25	M7,M8,L8	Nodaway River	16.5	13.8	2.2
Unnamed #02	3	60-36-27	M8	Lincoln Creek		3.0	
Unnamed #03	3	60-36-14	L8	Lincoln Creek		2.7	
Carroll Branch	3	60-37-23	L7,M7	Nodaway River		4.7	
Unnamed #04	3	60-37-23	L7,L8	Nodaway River		5.1	
Arapahoe Creek	5	61-36-31	L7,L8,K8	Nodaway River	16.9	12.6	6.7
Pedlar Creek	4	61-36-30	L7,L8,L9	Arapahoe Creek	11.2	9.4	2.8
Unnamed #05	3	61-36-22	L8	Pedlar Creek		4.8	
Unnamed #06	3	61-36-24	L8	Pedlar Creek		2.2	
Owl Creek	3	61-36-19	L7,L8,K8	Arapahoe Creek		9.5	
Newland Creek	3	61-36-09	L8,K8	Arapahoe Creek		8.4	
Unnamed #07	3	61-36-12	L8	Arapahoe Creek		1.9	
Unnamed #08	4	61-37-27	L7,L6	Nodaway River	7.0	6.7	0.4
Nichols Creek	3	61-37-33	L7	Unnamed #08		5.9	
Hickory Creek #1	3	61-37-22	L7,L6	Nodaway River		7.1	
Hog Creek	3	61-37-03	L7,K7,K6	Nodaway River		5.4	
Hayzlett Branch	3	62-37-35	K7,K8	Nodaway River		4.7	
Jenkins Creek	4	62-37-22	K7,K8,J8	Nodaway River	15.0	13.2	1.6
Unnamed #09	3	62-36-18	K8	Jenkins Creek		2.2	
East Fork #1	4	62-36-08	K8	Jenkins Creek		5.2	0.0
Unnamed #10	3	62-36-09	K8	East Fork #1		2.5	
Elkhorn Creek	4	62-37-22	K7,J7,J8	Nodaway River	20.4	18.5	1.7
East Branch	3	63-37-35	K7,K8,J8	Elkhorn Creek		8.8	
Highly Creek	4	62-37-16	K7,K6	Nodaway River		9.5	0.0
Unnamed #11	3	62-37-16	K7,K6	Highly Creek		5.7	
Bagby Creek	3	63-37-21	J7	Nodaway River		4.7	
Unnamed #12	3	63-37-16	J7	Nodaway River		2.8	
Unnamed #13	3	63-37-16	J7	Nodaway River		1.9	
Hickory Creek #2	3	63-37-08	J7,J6	Nodaway River		4.7	
Burr Oak Creek	3	64-37-33	J7,J6	Nodaway River		5.8	
Florida Creek	4	64-37-33	J7,J8,I8	Nodaway River	14.6	13.3	1.8
Unnamed #14	3	64-37-26	J7	Florida Creek		2.6	
Unnamed #15	3	64-37-24	J7,J8,I8	Florida Creek		5.7	
Unnamed #16	3	64-36-17	J8	Florida Creek		2.7	
Unnamed #17	3	64-37-21	J7,J6	Nodaway River		7.1	
Sand Creek	4	64-37-21	J7,I7,I8	Nodaway River	12.6	11.4	1.0
Unnamed #18	3	65-36-30	I7,I8	Sand Creek		2.3	
Unnamed #19	3	64-37-21	J7	Nodaway River		2.0	
Bowman Branch	3	64-37-16	J7,I7	Nodaway River		5.1	
Huff Creek	3	64-37-05	I7,J7,J6	Nodaway River		5.9	
Headrick Branch	3	65-37-32	I7,I6	Nodaway River		6.0	
Hagey Branch	3	65-37-29	I7,I6	Nodaway River		4.5	
Mill Creek	4	65-37-17	I7,H7,H6	Nodaway River	20.3	12.3	10.0
Unnamed #21	3	65-37-06	I7,I6	Mill Creek		4.2	
Moss Branch	3	66-37-20	H7	Mill Creek		7.3	

Stream Name	Max. Order	Location at Mouth T R S	Map Numbers[1]	Receiving Stream	Original Length (Mi.)	Current Length (Mi.)	Miles Channe l-ized
Unnamed #22	3	66-37-17	H7,H6	Mill Creek		4.9	
West Mill Creek	3	67-37-31	H6,G6,G7	Mill Creek		15.9	
Middle Mill Creek	3	67-37-29	H7,G7	Mill Creek		8.6	
East Mill Creek	3	67-37-29	H7,G7	Mill Creek		5.7	
Cuyhoga Creek	3	65-37-17	I7	Nodaway River		4.7	
Muddy Creek	3	65-37-04	I7,I8	Nodaway River		7.5	
Clear Creek	5	66-37-27	I7,H7,I8,H8	Nodaway River	17.9	15.6	3.8
South Fork Clear Creek	4	66-36-29	I8,H8	Clear Creek	22.4	16.8	8.6
Unnamed #23	3	66-36-33	I8	South Fork Clear Creek		3.3	
Unnamed #24	4	65-36-17	I8	South Fork Clear Creek	4.0	3.4	1.4
Unnamed #25	3	65-36-16	I8	Unnamed #24		1.8	
Unnamed #26	3	65-36-21	I8	South Fork Clear Creek		2.6	
Unnamed #27	3	65-36-22	I8	South Fork Clear Creek		4.6	
Unnamed #28	3	65-36-11	I8	South Fork Clear Creek		4.3	
Unnamed #29	4	66-36-22	H8	Clear Creek	7.4	7.0	0.4
Unnamed #30	3	66-36-14	H8	Unnamed #29		2.8	
Sink Creek	3	66-37-23	H7,H8	Nodaway River		5.7	
Unnamed #31	3	66-37-01	H7	Nodaway River		5.6	
Buchanan Creek	4	67-36-19	H7,H8,G8	Nodaway River	19.3	14.4	6.7
Unnamed #32	3	67-36-21	H8	Buchanan Creek		3.3	
Unnamed #33	3	68-36-36	G8	Buchanan Creek		3.3	
Unnamed #34	3	68-35-30	G8	Buchanan Creek		3.0	
Unnamed #35	3	67-36-19	H7	Nodaway River		2.5	
West Nodaway River	6	67-36-07	G7,F7,F8,E7, E8,D8,C8,C9, B9,C10,B10	Nodaway River	* 109.1	73.5	40.9
Unnamed #36	3	67-36-06	G7	West Nodaway River		2.7	
No Business Creek	3	68-37-36	G7	West Nodaway River		3.4	
South Branch	4	68-36-18	G7	West Nodaway River	6.2	5.9	0.5
Unnamed #37	3	68-36-18	G7	South Branch		4.3	
North Branch	3	69-36-29	G7,F7	West Nodaway River		5.3	
Ditch Number 10 (Neele Branch)	4	69-36-16	F8,F7,E7	West Nodaway River	13.1	12.1	1.6
Unnamed #38	3	69-37-12	F7	Neele Branch		3.3	
Wolf Run	3	70-36-09	F7,E7,E8,F8	West Nodaway River		5.7	
Unnamed #39	3	70-36-05	E7	West Nodaway River		4.0	
Middle Nodaway River	5	70-36-33	E8,D8,D9, D10,C10,C11, B11,B12,A11	West Nodaway River	* 85.7	59.5	35.6
Unnamed #40	3	71-36-11	E8	Middle Nodaway River		3.0	
Unnamed #41	3	71-36-01	E8	Middle Nodaway River		1.7	
Unnamed #42	3	72-35-21	D8,D9	Middle Nodaway River		2.4	
Unnamed #43	3	72-35-21	D8	Middle Nodaway River		4.1	
Unnamed #44	3	72-35-15	D9	Middle Nodaway River		3.4	
Show Creek	3	72-35-11	D9	Middle Nodaway River		6.7	

Stream Name	Max. Order	Location at Mouth T R S	Map Numbers[1]	Receiving Stream	Original Length (Mi.)	Current Length (Mi.)	Miles Channe l-ized
Unnamed #45	3	73-34-31	D9,D10	Middle Nodaway River		3.8	
Unnamed #46	3	73-34-28	D9,C9	Middle Nodaway River		3.9	
Unnamed #47	3	73-34-22	D10,C10,C9	Middle Nodaway River		4.6	
Unnamed #48	3	73-34-13	C10,D10	Middle Nodaway River		3.7	
Unnamed #49	3	73-34-12	C10	Middle Nodaway River		4.5	
Thompson Creek	3	73-34-12	C10	Middle Nodaway River		8.9	
West Fork	5	74-33-33	C10,B10,A10, A11	Middle Nodaway River	* 41.4	29.0	14.4
Unnamed #50	3	74-33-04	C10,B10	West Fork		6.5	
Rutt Branch	4	75-33-15	B10,B11,A11	West Fork	* A	10.2	
Unnamed #51	3	75-32-06	B11	Rutt Branch		3.7	
Unnamed #52	3	76-32-31	B11	Rutt Branch		3.8	
Ninemile Creek	3	75-33-04	B10,B11,A11	West Fork		9.5	
Unnamed #53	3	76-33-18	A10	West Fork		2.4	
Unnamed #54	3	76-33-18	A10,A11	West Fork		9.3	
Unnamed #55	3	77-33-31	A10	West Fork		3.4	
Unnamed #56	3	77-33-32	A10	West Fork		4.4	
Unnamed #57	3	74-33-27	C11	Middle Nodaway River		4.1	
Unnamed #58	3	74-32-06	C11,B11	Middle Nodaway River		4.9	
Unnamed #59	3	75-32-33	B11,B12	Middle Nodaway River		5.2	
Unnamed #60	3	75-32-01	B12	Middle Nodaway River		3.2	
Unnamed #61	3	76-32-36	B12	Middle Nodaway River		4.1	
Dunns Creek	3	71-36-04	E8,E7	West Nodaway River		5.6	
Unnamed #62	3	72-36-33	E8,D8	West Nodaway River		2.4	
Longs Branch	3	72-36-16	D8	West Nodaway River		9.5	
Sin Creek	3	73-36-33	D8,D9	West Nodaway River		11.1	
Sevenmile Creek	4	73-36-33	D8,D7,C7,B7, B8,C8,B9, B10,A10	West Nodaway River	* 57.6	38.6	24.8
Unnamed #63	3	73-36-29	D7	Sevenmile Creek		3.9	
Unnamed #64	3	73-36-20	D7,C7	Sevenmile Creek		3.2	
Rose Creek	3	73-36-05	C7,C8	Sevenmile Creek		8.1	
Unnamed #65	3	73-36-06	C7	Sevenmile Creek		4.6	
Unnamed #66	3	75-36-32	B7	Sevenmile Creek		3.8	
Unnamed #67	3	75-36-33	B8	Sevenmile Creek		4.4	
Hoyts Branch	3	75-35-29	B8,B9	Sevenmile Creek		8.0	
Unnamed #68	3	76-34-32	B9,B10	Sevenmile Creek		4.9	
Unnamed #69	3	76-34-28	B9,A9	Sevenmile Creek		4.1	
Threemile Creek	3	74-36-35	C8	West Nodaway River		9.3	
Williams Creek	4	74-36-35	C8,C9,C10	West Nodaway River	22.1	18.3	5.3
Petersons Creek	3	73-35-04	C8,C9	Williams Creek		4.8	
Moore Creek	3	73-35-01	C9	Williams Creek		5.2	
Unnamed #70	3	74-35-30	C8,C9	West Nodaway River		4.7	

Stream Name	Max. Order	Location at Mouth T R S	Map Numbers[1]	Receiving Stream	Original Length (Mi.)	Current Length (Mi.)	Miles Channe l-ized
Whistlers Branch	3	74-35-16	C8,C9,B9	West Nodaway River		6.1	
Elm Creek	3	74-35-12	C9,C10	West Nodaway River		6.1	
Unnamed #71	3	75-34-32	C9,B9	West Nodaway River		4.8	
Unnamed #72	3	75-34-23	B10	West Nodaway River		4.3	
East Nodaway River	5	67-36-07	G7,G8,F8,E8, E9,E10,D10, D11,C11,C12	Nodaway River	121.8	73.4	48.9
Unnamed #73	3	69-36-34	G8,F8	East Nodaway River		4.4	
Unnamed #74	3	69-36-14	F8	East Nodaway River		2.7	
Unnamed #75	3	69-36-12	F8	East Nodaway River		3.0	
Unnamed #76	3	70-35-31	F8,F9	East Nodaway River		6.4	
Unnamed #77	3	70-35-19	F8,F9	East Nodaway River		5.4	
Long Branch	4	70-35-17	F8,E8,E9	East Nodaway River		9.0	0.0
Unnamed #78	3	70-35-09	E8,E9	Long Branch		3.4	
Unnamed #79	3	71-35-16	E8,E9	East Nodaway River		4.5	
Kemp Creek **	4	71-35-11	E9,D9,D10, D11,C11	East Nodaway River	25.3	20.1	8.9
Unnamed #80	3	73-33-27	D10,D11	Kemp Creek		3.9	
Unnamed #81	3	71-34-08	E9,D9	East Nodaway River		3.0	
Brown Branch	4	72-33-29	D10	East Nodaway River	6.1	5.8	0.2
Unnamed #82	3	72-33-16	D10	Brown Branch		3.1	
Unnamed #83	3	72-33-26	D11,E11	East Nodaway River		4.6	
Mt. Zion Branch	3	72-33-13	D11	East Nodaway River		6.2	
Unnamed #84	3	72-33-08	D11	East Nodaway River		3.6	
Unnamed #85	3	72-32-08	D11	East Nodaway River		4.7	
Cipra Branch	3	72-32-09	D11,D12	East Nodaway River		7.5	
East Fork #2	3	73-32-33	D11,D12,C12	East Nodaway River		12.0	
Kosar Branch	3	73-32-21	D11,C11	East Nodaway River		5.6	
Shanghai Creek	4	73-32-16	C11,C11,C12	East Nodaway River	18.1	12.9	8.0
Unnamed #86	3	73-32-03	C11,C12	Shanghai Creek		4.7	
Unnamed #87	3	74-32-34	C11	Shanghai Creek		6.4	

[1] - Index numbers of topographic maps used in calculating stream and river statistics for the Nodaway River Basin (see Appendix C).
* - Orthophoto quadrangle map coverage incomplete so distances are estimated using available coverages
**- Most of the altered distance is due to impoundment from Lake Icaria.
A - No orthophoto quadrangle map coverage available so estimates of alteration were not calculated.

Appendix C. Index numbers and names for 7.5 minute series topographical maps covering the Nodaway River basin.

6	7	8	9	10	11	12	13
			ANITA (1971)	ADAIR SOUTH (1971)	CANBY (1971)	ROSSERDALE (1983)	**A**
	LEWIS (1971)	ANITA SW (1971)	MASSENA (1971)	FONTANELLE SW (1971)	FONTANELLE (1971)	GREENFIELD (1983)	**B**
	GRISWOLD NE (1978)	GRANT (1980)	DEWEY (1980)	BRIDGEWATER (1980)	NEVINVILLE (1980)	ORIENT (1980)	**C**
	WALLIN (1978)	MORTON MILLS (1980)	CARBON (1980)	CORNING NORTH (1980)	PRESCOTT (1980)	CRESTON WEST (1981)	**D**
	STANTON (1978)	VILLISCA (1980)	BROOKS (1980)	CORNING SOUTH (1980)	lENOX (1980)		**E**
	CLARINDA NORTH (1978)	HAWLEYVILLE (1980)	GUSS (1980)				**F**
COIN (1981)	CLARINDA SOUTH (1981)	NEW MARKET (1980)	LADOGA (1980)				**G**
BLANCHARD (1981)	CLEARMONT (1981)	HOPKINS SW (1980)					**H**
SKIDMORE NW (1981)	BURLINGTON JUNCTION	WILCOX (1985)					**I**
DOTHAM (1981)	SKIDMORE (1981)	MARYVILLE WEST (1984)					**J**
MOUND CITY (1981)	MAITLAND (1981)	BOLCKOW NW (1984)	BARNARD (1984)				**K**
KIMSEY CREEK (1981)	NEW POINT (1981)	FILLMORE (1984)	BOLCKOW (1984)				**L**
	FORBES (1972)	AMAZONIA (1972)	SAVANNAH (1978)				**M**

STREAM FLOW

The average discharge for the Nodaway River near Graham, MO from water years 1983-1996 was 1,011 cubic feet per second (cfs). The maximum instantaneous peak flow on the Nodaway near Graham was 78,300 cfs in 1993, and the maximum instantaneous peak flow on the West Nodaway was 31,100 cfs at Clarinda, IA in 1947 (Table 7). The Nodaway River makes up 0.4 % of the drainage area and about 1 % of the average annual flow of the Missouri River at their confluence.

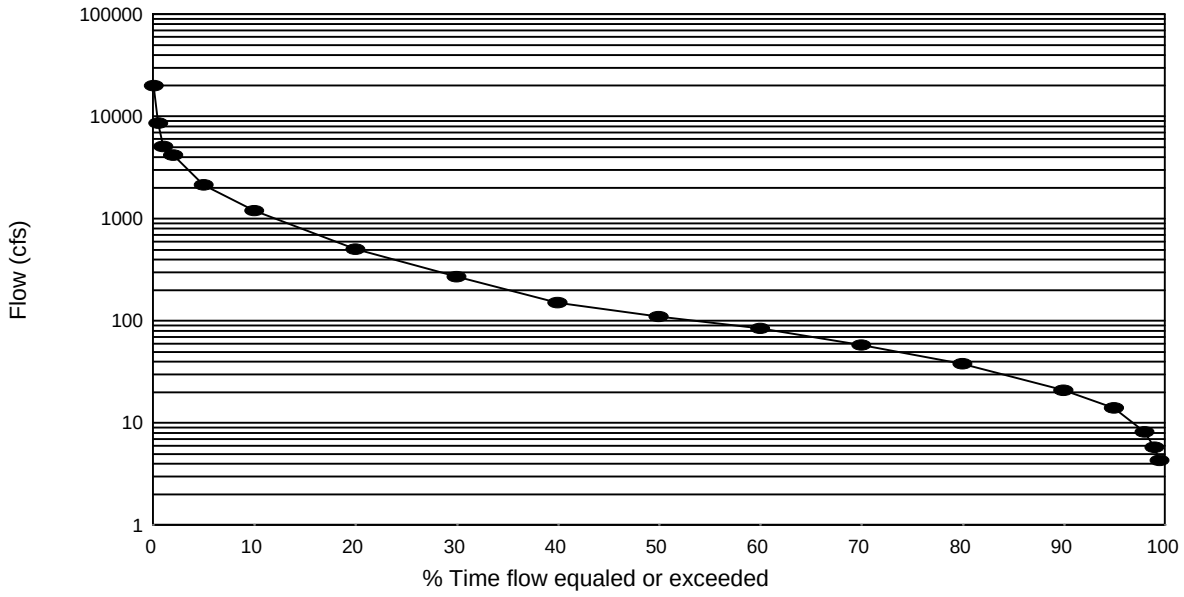
Table 7. Discharge information (cfs) for the total period of record at two gauge locations in the Nodaway River basin (USGS 1995a, USGS 1996a).

Location	Maximum Discharge	Minimum Discharge	Mean Discharge	10% Exceeds	50% Exceeds	90% Exceeds
Nodaway River Graham, MO	78,300 9-22-1993	23 9-9-1985	1,011	2,760	265	72
Nodaway River Clarinda, IA	31,100 6-13-1947	1.3 12-25-1923	380	820	100	19

The Nodaway River has contributed as much as 20 percent to the Missouri River flood crest when concurrent high flows occurred (USCOE 1973). Flood magnitude in cubic feet per second

for various recurrence intervals on the Nodaway River at Burlington Junction, Missouri was calculated to be: 12,300 for two year, 22,600 for five year, 30,500 for ten year, 41,200 for twenty-five year, 50,000 for fifty year, and 58,400 for 100 year flood events (Hauth 1974). The Nodaway River basin has highly variable flows as shown by its flow duration curve (Figure 3). Streams in the basin tend to rise and subside swiftly in response to precipitation events.

Figure 3. Flow duration curve for the Nodaway River near Burlington Junction, Missouri (Skelton 1976).



7-DAY Q_2 AND Q_{10} LOW FLOWS

Streams in the Dissected Till Plains Region, including the Nodaway River, have poor low flow potentials due to low hydraulic conductivity of area soils and poor land use practices. Low flows in the basin usually occur in the months of August, September, and October (Skelton 1976). Low flow characteristics can usually be generalized in plains streams based upon the size of the drainage area. Streams with basin areas less than 100 mi^2 will almost always have 7-day average minimum flows at recurrence intervals of two years (7-day Q_2) of zero. About 60 percent of plains streams with drainage areas of 100 to 200 mi^2 will have 7-day Q_2 of zero and the remainder will have 7-day Q_2 of 0.1 to 1.0 cfs. This method is unreliable for basins with drainage areas larger than 200 mi^2 and field observations are required. The 7-day average minimum flows at 10 year intervals (7-day Q_{10}) for drainage basins of 200 mi^2 or less are almost always zero. About 70 percent of plains streams with drainage areas or 200 to 1,000 mi^2 will have 7-day Q_{10} of

zero and the remainder will have 7-day Q_{10} of 0.1 to 1.5 cfs. For drainage basins larger than 1,000 mi^2 field observations of flow are required (Skelton 1976). Table 8 shows low flow data for reporting gauge stations in the Nodaway River basin.

Table 8. 7-day Q_2 and 7-day Q_{10} seasonal low flows for the Nodaway River basin (Skelton 1970).

Station Number	Station Location	Period of Record	Basin Area (mi^2)	7-day Q_2 (cfs)	7-day Q_{10} (cfs)
06817500	Burlington Junction, MO, Nodaway River	1922-1965	1,240	43	9.2
06817800	Oregon, MO, Nodaway River	1942-1943	1,770	58	10

DAM AND HYDROPOWER AND INFLUENCES

There are no major dams in the basin. There are a few moderate-sized reservoirs and a large number of small ponds in the Nodaway River basin. The larger bodies of water are public impoundments. Due to small size and ease of construction, the number of ponds can change very rapidly. Many ponds are built without needing permits and statistics on ponds are usually compiled by county rather than watershed. These factors complicate getting accurate, up-to-date information on ponds. Concern exists over the effects these ponds have on low-flow conditions as they intercept runoff and allow little or no adjustment for maintenance of stream flows.

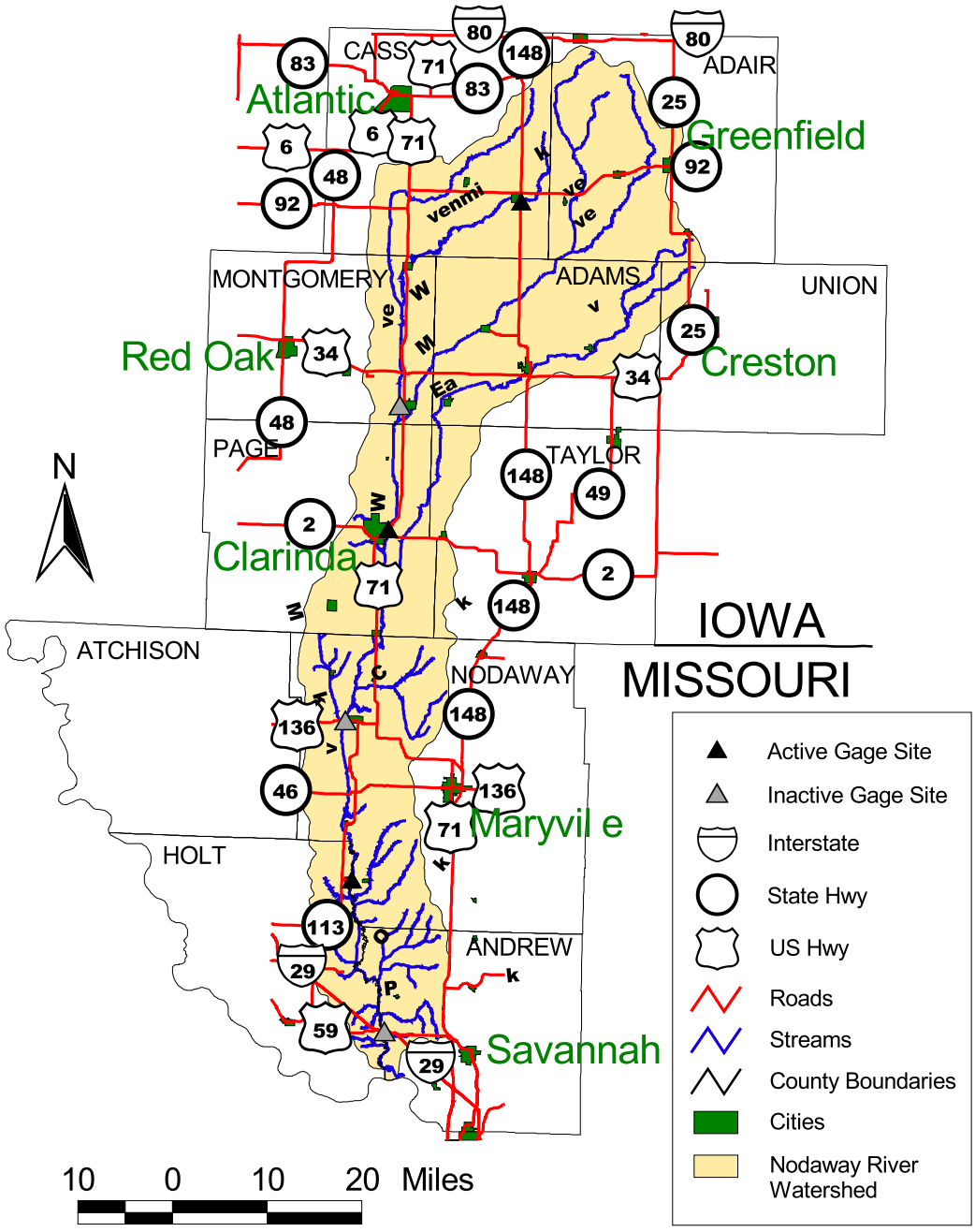


Figure ga. Active and inactive gage sites in the Nodaway River watershed.

WATER QUALITY

BENEFICIAL USE ATTAINMENT

The Nodaway River system is designated as suitable for aquatic life, fishing, wildlife and livestock watering (MDNR 1986a, MDNR 1995, IAC 1995). A 12 mile section of the river upstream of Clarinda, Iowa is designated as a raw water source for potable water supply (IADNR 1997a). Several small lakes in the Iowa section of the basin are designated for water supply and/or whole body contact (IADNR 1997a). The Nodaway River basin in Iowa was assessed as partially supporting its designated uses (IADNR 1997b). Small isolated reaches of quality habitat and diverse aquatic communities were found but these were considered atypical of the basin in general (IADNR 1997b). The designation of partially supporting means that a healthy community of regionally distributed aquatic species, expected to be encountered in sampling, are limited in the system (IADNR 1997a). Numbers and diversity of aquatic organisms are expected to remain low because of channelization, sedimentation, and periodic low dissolved oxygen concentrations (MDNR 1995). Soil erosion, sediment deposition, and turbidity all contribute to aquatic habitat degradation (MDNR 1986a). The main water problem in the Nodaway basin in Iowa is agricultural non-point source pollution in the form of sediment (IADNR 1997b). If erosion, stream channel modification, and increased nutrient inputs, and their related water quality problems continue, beneficial uses will not be attained in the future.

CHEMICAL QUALITY OF STREAM FLOW

It is probable that the streams in northwest Missouri were historically turbid during and after periods of high discharge due to the nature of the soils in the area. The activities of man, chiefly channelization and poor agricultural practices, have magnified sediment delivery, turbidity, and their associated problems in the waters of northwest Missouri (MDNR 1986a).

The trend in the Nodaway River from 1968 to 1984 was increasing nitrate concentrations due to agriculture (fertilizer runoff and animal wastes; MDNR 1986a). Water quality at low flows deteriorates due to lack of water volume to dilute point and non-point source pollution (MDNR 1986a). Soil erosion, sediment deposition, and turbidity all contribute to water quality degradation (MDNR 1986a). Temperatures in excess of 27^{o} C are detrimental to spawning and egg development of many fish. Because of shallow water and low flows, this temperature is probably exceeded regularly in the Nodaway River and its tributaries (USDA-SCS 1982). Minimal effects are seen from sewage treatment plants (MDNR 1995). In general water quality in the Nodaway basin in Iowa is good, but low flows and excessive sediment cause problems and threaten to further degrade water quality if current agricultural practices continue (IADNR 1997b). Table 9 presents data for water quality in the Nodaway River in Missouri for two years and how they compare to state established water quality standards.

CONTAMINANTS, FISH KILLS, AND HEALTH ADVISORIES

Fish consumption advisories have been issued for all waters of Missouri, excluding the Ozarks, by the Missouri Department of Health (MDOH) since 1985 (MDOH 1996). The MDOH recommends eating no more than one pound per week of bottom feeding fish such as catfish,

buffalo, drum, common carp, suckers, and paddlefish, from the Nodaway River and its tributaries

(MDC 1997). No consumption advisories apply to bass, sunfish, crappie, or walleye (MDOH 1996).

In 1971, Reliable Rendering Company of Quitman, Missouri was reportedly discharging untreated waste into the Nodaway River, which posed a health and odor problem, but was small enough in quantity that it probably created no measurable effect on water quality (Ryck MDC, internal memo May 20, 1971). In 1984 a fish kill on the East Nodaway River in Iowa was caused by a pesticide spill, but the magnitude and number of fish killed were not known (John Olson IADNR, personal communication).

With the erosive nature of area soils and the increased water velocities due to channelization, several emergency channel stabilization efforts have been undertaken to prevent undermining of bridges, roads, and pipelines. If the river were to erode around a buried pipeline, a significant spill could occur with detrimental effects on downstream habitat and wildlife (MDC files).

A possible threat to the basin is the increasing number of concentrated animal feeding operations. Manure spills and improper land application of waste residues from these facilities have caused serious water quality problems and fish kills in other river basins in Missouri (MDNR 1996a). Low base flows and the reduced volume of water associated with them could create serious problems for aquatic communities in the Nodaway River basin if improper disposal practices at one of these facilities were to occur.

WATER USE

Municipal

Several communities including Maitland, Clearmont, Graham, Skidmore, Fillmore, and Burlington Junction in Missouri, and Greenfield, Fontanelle, Nodaway, Prescott, Cumberland, Villisca, College Springs, Braddyville, and Shambaugh in Iowa withdraw water from the unconsolidated aquifer near the Nodaway River. Both Clearmont and Maitland, Missouri have a chronic problem of drinking water exceeding the standard for nitrate contamination (MDNR 1995). The primary source suspected of creating the problem is local agricultural activities (MDNR 1995). Groundwater in the Nodaway basin in Iowa generally does not meet Iowa Department of Environmental Quality (IDEQ) standards for drinking water due to excessive total dissolved solids, nitrates, iron, manganese, chloride, and/or sodium (USDA 1981).

Surface water is usually high in iron or manganese but is economically treatable and total dissolved solids and nitrates normally meet the standards set by the IDEQ (USDA 1981). The only surface water intake on the Nodaway River for municipal drinking water use is at Clarinda, Iowa. Several small lakes in the Nodaway watershed, in Iowa, are surface water sources for municipal water supply (IADNR 1997a).

Agricultural

Livestock watering is the largest water use in the Nodaway River basin (MDNR 1986a). Small areas have been irrigated but highly mineralized and unreliable water sources have limited this practice (USCOE 1973). In 1977, about 21,000 acres were irrigated in northwest Missouri. This was projected to increase to 100,000 acres by the year 2000 with the Nodaway River basin

included in the area where the greatest increase would occur (Skelton, et al. 1982). Irrigation in Andrew, Holt, and Nodaway counties totaled 42.8 million gallons in 1996 (MDNR 1996a).

POINT SOURCE POLLUTION

Only 0.7 miles of the Nodaway River system in Missouri was estimated to be impacted by point source pollution from sewage treatment plants (MDNR 1995). These areas were small reaches below the Burlington Junction and Skidmore, Missouri sewage treatment plant discharges (MDNR 1995). There are no permitted discharges of metals or toxic organic materials in the Missouri section of the Nodaway basin (MDNR 1995). Table 10 lists all permitted wastewater discharges (Figure wt) in the Nodaway River basin. Table 11 lists all other point source discharges in the Nodaway River Basin.

Concentrated animal feeding operations (CAFOs) are a growing presence in the basin (38,536 Population Equivalency units (PE) in MO, and 63,300 PE in IA). A listing of all permitted CAFOs (Figure wt) in the basin are found in Table 12. History indicates that problems with discharges from these operations sometimes occurs. This could seriously impact the water quality and aquatic organisms in the Nodaway River basin should an accidental discharge occur.

The number of hogs and cattle in the basin are considered to be equivalent to a human population of 1.03 million (MDNR 1995). This is roughly 30 times larger than the human population in the basin. Concentrated animal feeding operations are classified as point source discharges and make up 101,836 PE in the basin. The remainder are from ranging livestock.

NON-POINT SOURCE POLLUTION

Non-point source pollution causes most water quality problems in the Nodaway River basin (MDNR 1995). Soil erosion, sediment deposition, and turbidity all contribute to water quality degradation (MDNR 1986a). Soil erosion, channelization, and livestock waste are the three main sources of non-point source pollution (MDNR 1995).

In 1980, soil erosion was estimated to be 17.1 tons/acre/year due to sheet erosion, 4.8 tons/acre/year due to gully erosion, and the sediment yield by streams was 6.1 tons/acre/year (Anderson 1980). On some cropland not protected by conservation practices, the soil loss rate was found to be as high as 30 tons/acre/year (USDA-SCS 1983). In 1995 the estimates were 13-18 tons/acre/year due to sheet erosion, 0.8 - 1.1 tons/acre/year due to gully erosion, and suspended sediment delivery by streams was 3.5 tons/acre/year (MDNR 1995). This indicates progress is being made but probably not enough to help the stream resources impacted by sediments.

Table 9. Selected water-quality data for the Nodaway River near Graham, MO at gauge station 06817700, water years 1993 and 1996 (USGS 1994, USGS 1997, Missouri Code of State Regulations 10 CSR 20.7).

	State Standard				Water Year	Water Year
Parameter	I	III	VI	VII	1993	1996
Temperature (Deg. C)	32 deg max				0.0-27.0	0.5-27.0
Specific Conductance (us/cm)					154-435	216-580
Oxygen, dissolved (mg/l)	5				6.0-14.3	6.7-18.6
Coliform, fecal (Cols./100 ml)				200-storm runoff	[K]150-[K]56,000	[K]24-[K]26,000
Streptococci, fecal (Cols./100 ml)					[K]110-[K]49,000	27-46,000
Total hardness (mg/l) CaCO3					61-180	130-190
Nitrogen, total ammonia + organic (mg/l as N)	dependent on pH and temp.				0.34-11.0	0.45-5.0
Phosphorus, total (mg/l as P)					0.14-1.2	<0.02-1.50
Manganese, dissolved (ug/l as Mn)		50		50	9-22	0.60-220
Iron, dissolved (mg/l as Fe)	1,000	300		300	12-400	5-24

[K]: Non-ideal count of colonies (e.g., sample was not diluted enough, colonies merged)

I: Protection of aquatic life

III: Drinking water supply

VI: Whole body-contact recreation

VII: Groundwater

Table 10. Permitted wastewater treatment facilities (WWTF) in the Nodaway River basin.

Facility	Receiving Stream	Location (T-R-S)	State	County
Fontanelle WWTF	Middle Nodaway River	75N-32W-19	IA	Adair
Bridgewater WWTF	West Fork	75N-33W-33	IA	Adair
Adams Co. Care Facility WWTF	East Nodaway River	71N-34W-01	IA	Adams
Corning WWTF	East Nodaway River	71N-34W-03	IA	Adams
Corning Quarry	East Nodaway River	71N-34W-10	IA	Adams
Nodaway WWTF	East Nodaway River	71N-35W-19	IA	Adams
Prescott WWTF	East Nodaway River	72N-33W-23	IA	Adams
Mt. Etna Quarry	Middle Nodaway River	73N-34W-14	IA	Adams
Fillmore WWTF	Trib to Lincoln Creek	60N-36W-07	MO	Andrew
Massena WWTF	West Nodaway River	75N-32W-19	IA	Cass
Cumberland WWTF	Houts Branch	75N-35W-28	IA	Cass
New Point Quarry	Trib to Nodaway River	61N-37W-27	MO	Holt
Maitland WWTF	Trib to Nodaway River	62N-37W-04	MO	Holt
MMA Maitland Quarry	Trib to Nodaway River	62N-37W-34	MO	Holt
DNR Viking Lake State Park	Dunns Creek	71N-36W-07	IA	Montgomery
Villisca WWTF	Middle Nodaway River	71N-36W-27	IA	Montgomery
Graham WWTF	Elkhorn Creek	62N-37W-11	MO	Nodaway
ANR Maitland Station	Elkhorn Creek	63N-36W-29	MO	Nodaway
Forcade Quarry	Elkhorn Creek	63N-37W-36	MO	Nodaway
Burlington WWTF	Nodaway River	65N-37W-08	MO	Nodaway
Elmo WWTF	Mill Creek	66N-37W-17	MO	Nodaway
Clearmont WWTF	Clear Creek	66N-37W-25	MO	Nodaway
Shambaugh Quarry	Nodaway River	67N-36W-19	IA	Page
Braddyville WWTF	Nodaway River	67N-36W-30	IA	Page
Shambaugh WWTF	West Nodaway River	67N-37W-01	IA	Page
College Springs WWTF	Mill Creek	67N-37W-18	IA	Page
Clarinda WWTF	West Nodaway River	69N-36W-29	IA	Page

Table 11. Permitted point source discharges in the Nodaway River basin.

Facility	Receiving Stream	Location (T-R-S)	State	County
Adair County Maintenance Yard	Tributary of Middle Nodaway River	75N-31W-7	IA	Adair
Bloom Auto Repair	Tributary of Middle Nodaway River	75N-34W-7	IA	Adair
Cardinal Insulated Glass Co.	Tributary of Middle Nodaway River	75N-34W-7	IA	Adair
Feeders Service Inc.	Tributary of Middle Nodaway River	75N-34W-7	IA	Adair
Greenfield Lawn & Leisure	Tributary of Middle Nodaway River	75N-34W-7	IA	Adair
Greenfield Manor Inc.	Tributary of Middle Nodaway River	75N-34W-7	IA	Adair
Iowa Dept. of Transportation	Tributary of Middle Nodaway River	75N-34W-7	IA	Adair
Mac's Electric & Hardware	Tributary of Middle Nodaway River	75N-34W-7	IA	Adair
Schildberg Cons.-Truck Shop	Tributary of Middle Nodaway River	75N-34W-7	IA	Adair
Siegwerk Inc.	Tributary of Middle Nodaway River	75N-34W-7	IA	Adair
Adams & Taylor Co. Regional	East Nodaway River	72N-34W-34	IA	Adams
AT&T Long Lines	East Nodaway River	72N-34W-35	IA	Adams
Brown Bear Corp.	East Nodaway River	72N-34W-27	IA	Adams
Burcliff Industries Inc.	East Nodaway River	72N-34W-27	IA	Adams
Curtis Animal Health Products	East Nodaway River	72N-34W-35	IA	Adams
Defender Company	East Nodaway River	72N-34W-34	IA	Adams
Iowa Dept. Of Transportation	Tributary of Kent Creek	72N-34W-22	IA	Adams
Precision Pulley Inc.	East Nodaway River	72N-34W-27	IA	Adams
Precision Inc. Corning # 2	East Nodaway River	72N-34W-27	IA	Adams
UARCO Inc.	East Nodaway River	72N-34W-35	IA	Adams
Wirecraft Iowa	East Nodaway River	72N-34W-35	IA	Adams
Bower Welding & Fabrication	Tributary of West Nodaway River	72N-34W-33	IA	Cass
IES Utilities Inc.	Houts Branch	75N-35W-22	IA	Cass
Lawrence Eilts	Sevenmile Creek	75N-35W-10	IA	Cass
Massena Ag Center	West Nodaway River	75N-34W-28	IA	Cass
Terra Western Corp.	Middle Nodaway River	71N-36W-27	IA	Montgomery
Villisca Lockers	Middle Nodaway River	71N-36W-27	IA	Montgomery
Southwestern Bell Tele. Co.	Nodaway River	65N-37W-16	MO	Nodaway
Southwestern Bell Tele. Co.	Nodaway River	65N-37W-16	MO	Nodaway
AT&T Long Lines	Tributary of Nodaway River	67N-37W-14	IA	Page

Facility	Receiving Stream	Location (T-R-S)	State	County
Cardinal Body Shop	Nodaway River	69N-36W-31	IA	Page
Carpenters Body Shop	Nodaway River	69N-36W-31	IA	Page
Deans Dry Dock	Nodaway River	69N-36W-31	IA	Page
H&H Trailer Company	Nodaway River	67N-37W-36	IA	Page
Iowa Dept. of Transportation	Nodaway River	69N-36W-31	IA	Page
Lisle Corp.	Nodaway River	69N-36W-31	IA	Page
NSK Corporation	Nodaway River	69N-36W-31	IA	Page
Sherwin-Williams	Nodaway River	69N-36W-31	IA	Page
Snyders Auto Body & Paint	Nodaway River	69N-36W-31	IA	Page
Wynn's Ag Center Inc.	Nodaway River	69N-36W-31	IA	Page

Table 12. Permitted Concentrated Animal Feeding Operations (CAFOs) in the Nodaway River basin.

Facility Name	Facility ID	County/State	Design Pop. Equivalent	Animal Units[1]	Animal Type[2]	Facility Type[3]	Location
Ambrose, Robert	LA7000206	Nodaway MO	1,100	500	SF		63N-38W-12
Archibald, Charles	LA7000239	Andrew MO	315	70	SS		59N-36W-19
Barr, William B.	LA7101321	Andrew MO	792	360	SF		61N-37W-12
Blackford, Ercille	LA7000205	Nodaway MO	660	300	SF		66N-37W-11
Burnett, Jerry	LA7103822	Holt MO	1,950	Unknown	SN	AE LA	59N-37W-03
Coston, W.F.	LA7100048	Nodaway MO	880	400	SF		64N-37W-35
Custer, B.	LA7000204	Holt MO	2,613	310	SS		62N-37W-06
Fink and Kurtz Farm	LA7000027	Holt MO	440	200	SF	AN LA	60N-37W-34
Flangan, Randy	LA7000212	Nodaway MO	1,164	152	SS		67N-36W-34
Gresky, Robert	LA7000510	Nodaway MO	792	360	SF		65N-37W-26
H.R.S. Farms	LA7102907	Holt MO	13,538	967	BF	AN LA (2)	63N-37W-20
Hansen, Paul A. Jr.	LA7000077	Nodaway MO	550	250	SF		64N-36W-33
Jennings, Donald	LA7101720	Andrew MO	376	24	SS	AN LA	59N-36W-06
Logsdon, Clifton	LA7000192	Nodaway MO	3,075	450	SS		65N-36W-23
Luce, Jim	LA7000276	Holt MO	180	40	SS		61N-37W-29
MFA Livestock Assoc.	LA7000251	Nodaway MO	506	230	SF	AN LA	65N-37W-11
Nelson, Herschel	LA7000124	Nodaway MO	830	800	SN		62N-37W-11
Noellsch Stock & Grain	LA7000181	Holt MO	1,188	540	SF		60N-38W-13

Facility Name	Facility ID	County/State	Design Pop. Equivalent	Animal Units[1]	Animal Type[2]	Facility Type[3]	Location
NWMS Test Station	LA7000505	Nodaway MO	528	240	SF		64N-38W-13
Schafer, John	LA7000407	Nodaway MO	1,286	212	SS		62N-36W-10
Schafer, Martin	LA7000423	Nodaway MO	660	300	SF		63N-36W-35
Tally, Melvin	LA7000028	Nodaway MO	440	200	SF		63N-37W-01
Townsend, Dick	LA7100735	Andrew MO	924	420	SF		61N-36W-23
Vest, Roger	LA7103790	Nodaway MO	2,070	90	SS	AN LA CPIT	64N-36W-21
Walker, Mike	LA7102687	Andrew MO	175	250	SN		61N-36W-11
Sindt, Kevin		Cass IA	3,360*	224,000	swine		74N-36W-10
Cooper, Blake		Adams IA	8,100*	540,000	swine		72N-33W-01
Steele, Doug		Adair IA	7,560*	504,000	swine		76N-33W-18
Wheeler, Dale		Adams IA	28,350*	1,890,000	swine		72N-35W-19
McCarty, Karl		Adams IA	4,050*	270,000	swine		72N-33W-13
Rice, Gregory		Adams IA	4,050*	270,000	swine		73N-32W-16
West, Gary		Adams IA	4,050*	270,000	swine		72N-32W-20

[1] - Iowa animal units are reported in pounds of livestock

[2] - Swine finishing (SF), Swine nursery (SN), Sows, boars, farrowing (SS) unknown operation type listed by animal.

[3] - AE LA - aerobic lagoon, AN LA- anaerobic lagoon, CPIT - concrete pit

* - Based on MDNR conversion methodology where 1000 pounds equals 15 population equivalent units for swine

HABITAT CONDITIONS

CHANNEL ALTERATIONS

Extensive channelization has taken place in the Nodaway River basin. Large scale channelization was begun around 1900 by local drainage districts, and most of the channel modifications were completed by the 1930's (USCOE 1973, USDA 1981). The main purpose of channelization in the Nodaway River basin was to alleviate the problems of flooding and to increase the amount of tillable land. Data from a Missouri Department of Natural Resources study indicates that 94 of the original 105 miles of the Nodaway mainstem within Missouri have been channelized. Only the lower 11 miles of river remain unchannelized (MDNR 1986a). Only two streams fourth order or higher in the Nodaway basin have not experienced noticeable channelization (East Fork Number 1 and Highly Creek). About 78% of the original Nodaway River basin stream mileage has been altered by channelization (Table 13). Only 36% of the remaining mileage in fourth, fifth, and sixth order streams is not channelized. Since channelized systems rarely if ever recover (Binns 1978), the Nodaway River basin may never recover as a naturally meandering river system.

Channelization reduces channel length and increases stream gradient which in turn increases the streams ability to erode its bed and banks. This serves to isolate the stream from its original flood plain, and over time, creates a new flood plain. In the upper areas of the basin, significant gully erosion is occurring due to past channelization, causing instability in the smaller branching tributaries (USDA 1981). Channelization is responsible for increasing sediment bed load and reducing aquatic pool and riffle habitat, which in turn negatively alters the variety and quantity of aquatic life (USDA-SCS 1982).

Table 13. Miles of channelization for streams fourth order and larger in the Nodaway River basin.

Order	Streams (number)	Streams Unaltered	Original Miles	Miles Unchannelized (% of orig.)	Miles Altered (% of orig.)	Current Miles	Miles Channelized (% of current)
6	2[1]	0	226	50 (22)	176 (78)	138	88 (64)
5	5	0	284	81 (28)	203 (72)	191	110 (58)
4	23	2	351	188 (54)	163 (46)	283	95 (34)
4,5,6	30	2	861	319 (38)	542 (62)	612	293 (48)

[1] - The Nodaway River splits into three branches in its' upper reaches, the West Nodaway River, Middle Nodaway River, and East Nodaway River. The West Nodaway is a sixth order river and the East Nodaway a fifth order river where they join and form the Nodaway River. The West Nodaway and Nodaway River mileages are combined for this table.

UNIQUE HABITATS

Very little habitat in the Nodaway basin in Missouri or Iowa is seen as unique due to extensive disturbances to the watershed. In Missouri, only Long Prairie was classified as significant by Kramer (1993), but 11 sites were considered notable. Most of these areas were very small and exhibited signs of disturbance. The Nodaway River has two "Shut-ins" in Missouri, one just south of Maitland and the other just east of New Point (Beveridge 1978). In Page County, Iowa there is one remnant stand (less than two acres) of tallgrass prairie adjacent to the Hawleyville cemetery that is considered a unique natural element (Varland 1984). Woodside Prairie, a small privately owned prairie in Adair County is home to two endangered plant species, Meads milkweed and western prairie fringed orchid (Kevin Blazek, Adair County Conservation Board, personal communication). A high quality native prairie is also found in southeast Cass County, Iowa (T74N, R34W, sec. 13; Melanie Perry, Cass County Naturalist, personal communication).

IMPROVEMENT PROJECTS

A tree revetment was installed at Possum Walk Access near Elmo by the Missouri Department of Conservation in 1992. It was buried by silt after a high water event and no other projects have been attempted. Vince Travnichek (MDC) indicated that no long term bank stabilization occurred as a result of the project and it was not considered a success.

STREAM HABITAT ASSESSMENT

In Iowa there are remnant reaches of streams with good instream habitat (stable substrates, pool-run-riffle complexes, woody cover, and nominal riparian corridors) and diverse aquatic communities present (IADNR, 1997b). However, John Olson (IADNR) indicated that they were not typical of the Nodaway River basin as a whole in Iowa. Florida Creek, Nichols Creek, and Smith Creek had better habitat (less turbid water, deeper water, rocky stable bottoms, more pool-run-riffle complexity, and better riparian corridors) than other streams sampled in the Missouri section of the basin. Forested riparian corridors are generally narrow to non-existent along basin streams. Most streams are surrounded by cultivated row crops, or pasture. In areas that are intensively row cropped, levees are commonly encountered. Stream banks throughout the basin are usually high, steep, and show visible evidence of erosion (exposed soil, lack of vegetation, and bank sloughing). According to Schumm’s channel evolution model most streams in the Nodaway River basin in Missouri are stage three with near vertical banks and a flat channel bottom or stage four with aggrading of sediment and bar formation occurring (Schumm et al. 1984).

BIOTIC COMMUNITY

FISH COMMUNITY DATA

The first scientific fish collecting in the Nodaway River may have been conducted in the late 1880's or early 1890's (Jordan and Meek 1885). No specific article or documentation, however was located to confirm this. Harry Harrison (Iowa Conservation Commission fisheries biologist) undoubtedly collected fish from the Nodaway River basin in the 1950's, but his field notes were destroyed in a move in the 1970's (John Olson, Iowa Department of Natural Resources (IADNR), personal communication). The first documented collections were made by G. V. Harry from the University of Michigan, in conjunction with MDC, in the summers of 1940 and 1941. Perry E. Robinson conducted five samples, two of which were resurveys of Harry's sites, during the summer of 1957 (Pflieger 1971). These are the only known samples prior to 1995, and data from the Harry and Robinson samples are included in the MDC database at Columbia, Missouri. MDC personnel resurveyed one of these sites in 1995. The other four were resurveyed in 1997 along with eight additional sites. The recent and historic sample sites can be found on the maps in Appendix D (Figure ms).

During the early 1990's, John Olson (IADNR) conducted seine surveys at fourteen sites in the Iowa portion of the basin (sample sites can be found on the maps in Appendix D, Figure is) in conjunction with a study of the designated use for warm water streams. Information from these samples can be found in Appendix G.

Fourteen sites were sampled by MDC personnel between 1995 and 1997. Five of these were surveys (using seines and electroshocking), of historical collection sites, originally sampled between 1940 and 1957 (Table 14). Eight sites were sampled for the first time in 1997. In 1997, thirteen sites were sampled in conjunction with basin planning efforts and 5,913 fish were collected. The collections and/or records are housed at the MDC Northwest Regional Office, St. Joseph, Missouri.

Forty-seven fish species, representing twelve families have been sampled or otherwise documented as occurring in the Nodaway River basin. The families in order by number are: Cyprinidae (15 species), Catostomidae (8 species), Centrarchidae (7 species), Ictaluridae (5 species), Percidae (4 species), Lepisosteidae (2 species), and Polyodontidae, Esocidae, Hiodontidae, Clupeidae, Moronidae, Sciaendae (1 species each). Forty-three of these can be classified by faunal region. The samples are representative of five faunal regions: big river (32.6%), wide ranging (32.6%), prairie (20.8%), Ozark-prairie (9.3%), and Ozark (4.7%). A list of common and scientific names can be found in Appendix E. For the sake of simplicity only the common names will be used in the text of this document.

Thirty-three species were collected during current sampling efforts (1995-1997) and are the basis for the following comparisons. Seventeen species collected in recent samples had not previously been documented in the basin. Lack of documentation can be attributed to limited sampling in the past.

Table 14. Historic sample sites for fish in the Missouri portion of the Nodaway River basin.

Location Number	Stream Name	Location T-S-R	Date Sampled	Sample Gear[1] K D E	Number of Species[2] L N B H T
0957A	Nodaway River	62N-37W-09	13 Jul 40	? X	2 6 1 9
0956A	Nodaway River	66N-37W-01	12 Jul 41	? X	4 4 1 9
0956B	Nodaway River	66N-37W-01	06 Aug 57	X	3 4 7
0957B	Nodaway River	62N-37W-09	07 Aug 57	X	4 3 1 8
1385B	Nodaway River	65N-37W-17	07 Aug 57	X	5 3 8
1386B	Nodaway River	64N-37W-21	08 Aug 57	X	3 3 1 7
1387B	Nodaway River	59N-37W-01	08 Aug 57	X	4 2 6

1 - K = kick seine D = drag seine E = electrofishing
2 - L = large fish species N = nektonic fish species B = benthic fish species H = herbivorous fish species T = total fish species

Two species, flathead chub and quillback, that had been collected between 1940 and 1957 in Missouri, were absent from recent MDC samples. Quillback/plains carpsucker were captured at 8 of 14 sites in the 1990 IADNR survey by John Olson. Flathead chubs were found at four of the 14 sites surveyed.

The flathead chub in Missouri is listed as state endangered (MDC 1997) and is currently being considered for federal listing (Paul McKenzie, USFWS, pers. comm.). Pflieger (1997) noted that their preferred habitat in northwest Missouri was pools of small creeks with moderately clear waters, little current, and a bottom composed of coarse gravel and bedrock. Descriptions from Olson (IADNR, personal communication) indicate that this type of habitat was present at three of the four sites where flathead chubs were collected in Iowa. This may explain their absence in Missouri, since these conditions are rare in the lower basin. A few tributaries near the mouth of the Nodaway River have comparable habitat. Quillback are most abundant in clear prairie streams having stable bottoms composed of gravel or other coarse material (Pflieger 1997). Conditions in the Nodaway River basin in Missouri make this type of habitat virtually non-existent.

The most widely distributed species in the basin was the red shiner. It was present at all sample sites in Missouri, 13 of the 14 Iowa sample sites, and made up roughly 60% (by number) of the recent Missouri samples. The highest relative abundance of red shiners at a single site was 89.0%. They made up greater than 50% of the sample at five sites, and more than 33% of the sample at 13 of the 14 Missouri sites. Comparisons are made at two historically sampled locations (Table 15). Locality number 0956, first sampled in July of 1941, had a red shiner

Table 15. Relative abundance comparisons (percent) between historic and recent collections from sites 0956 and 0957 (MDC data base).

Species (common name)	0956		0957	
	1941	1995	1941	1997
Red Shiner	3.5	66.2	1.5	81.9
Sand Shiner	46.7	20.1	11.2	4.4
Emerald Shiner	0.0	2.3	0.0	3.0
Bigmouth Shiner	0.0	1.4	0.0	0.0
Fathead Minnow	40.6	0.0	11.9	2.2
Plains Minnow	3.5	0.0	46.3	0.0
Suckermouth Minnow	2.6	0.0	3.0	0.4
Flathead Chub	0.0	0.0	0.8	0.0
Silver Chub	0.0	0.0	0.8	0.0
Speckled Chub	0.0	0.0	0.0	0.2
Common Carp	0.0	0.9	0.0	0.0
River Carpsucker	0.4	0.0	0.0	1.0
Goldeye	0.4	0.0	20.9	0.0
Gizzard Shad	0.0	0.0	0.0	0.2
Channel Catfish	1.8	0.5	3.7	6.2
Black Bullhead	0.4	0.0	0.0	0.0
Green Sunfish	0.0	0.5	0.0	0.4
Bluegill	0.0	6.4	0.0	0.0
Orangespotted Sunfish	0.0	0.5	0.0	0.0
Largemouth Bass	0.0	0.5	0.0	0.0
Sauger	0.0	0.0	0.0	0.2
White Crappie	0.0	0.9	0.0	0.0

relative abundance of 3.5%. In the October 1997 sample from this site, red shiner relative abundance was 68.9%. Similar changes were seen at the other comparable site, locality number 0957. The July 1940 sample had a red shiner relative abundance of 1.5% while the relative

abundance from July 1997 was 81.9%. Based on these comparisons, it appears that the red shiner's generalist nature and tolerance for degraded conditions has allowed it to proliferate over other fishes in the Nodaway River basin during the past four decades. At sites where red shiner relative abundance increases were noted, decreases in relative abundance were observed in sand shiners, fathead minnows, and suckermouth minnows (Table 15). Red shiners were the most commonly collected open water species. Other open water species commonly collected were sand shiners, bigmouth shiners, creek chubs, fathead minnows, and emerald shiners. Central stonerollers, plains minnows, silver chubs, and speckled chubs were collected in small numbers (Appendix F).

The most commonly sampled large fishes were channel catfish, river carpsuckers, green sunfish, and common carp. These fish are all tolerant of the degraded conditions commonly found in the Nodaway River basin. Other fish collected were shortnose gar, longnose gar, goldeye, gizzard shad, bigmouth buffalo, smallmouth buffalo, white sucker, shorthead redhorse, yellow bullhead, black bullhead, flathead catfish, black crappie, bluegill, largemouth bass, sauger, and freshwater drum.

Benthic species were the least represented group. The only documented species in this category was suckermouth minnow (sampled at six of the fourteen sites) comprising only 0.8% of the total sample.

AQUATIC INVERTEBRATES

Oesch (1984) indicated that six species of freshwater mussels historically occurred in the Nodaway River basin (Table 16). Sue Bruenderman (MDC, personal communication) has indicated that in recent surveys of northern Missouri streams, mussels have been found that were thought to be eliminated. No current collections of mussels in the Nodaway River basin were located.

Table 16. Mussels historically found in the Nodaway River basin in Missouri (Oesch 1984)

Common Name	Scientific Name	Period Last Collected
Fragile paper shell	*Leptodea fragilis*	Before 1920
Maple leaf	*Quadrula quadrula*	Before 1920
Pink heel-splitter	*Potamilus alatus*	Before 1920
Pink paper shell	*Potamilus ohiensis*	Before 1920
Pistol-grip	*Tritogonia verrucosa*	Before 1920
White heel-splitter	*Lasmigona complanata*	Before 1920

Three crayfish have ranges that include the Nodaway river basin (Table 17). Crayfish were captured at several 1997 sampling locations, but none were preserved or identified.

Table 17. Crayfish species found in the Nodaway River basin (Phillips 1980, Pflieger 1996).

Common Name	Scientific Name	State
Devil crayfish	*Cambarus diogenes*	MO/IA
Papershell crayfish	*Orconectes immunis*	MO
Northern crayfish	*Orconectes virilis*	MO/IA

Very limited collection of aquatic insects has been done in the Nodaway River basin in Missouri. Sampling of adult dragonflies in the Nodaway River basin in Missouri was conducted in 1997 by Linden Trial (MDC, personal communication). The results can be found in Appendix H. One other documented insect collection (butterfly's) was obtained from Kevin Blazek of the Adair County Conservation Board. Observations in 5 counties were made and 58 species of butterfly's were identified. Fourteen species were recorded from Adair county (Woodside Prairie in the Nodaway River basin was one site specifically mentioned).

REPTILES AND AMPHIBIANS

Some reptiles (Table 18) and amphibians (Table 19) of interest whose ranges include part of the Nodaway River basin are the western fox snake, massasauga rattlesnake, great plains toad, plains spadefoot toad, and great plains narrowmouth toad (Dr. Dave Easterla, NW Missouri State University, personal communication). All of these species have a strong wetland-plain or river floodplain association. Due to extensive basin modification, most of these species are restricted to isolated areas of remaining suitable habitat. Recent collections in northwest Missouri and southwestern Iowa have been in isolated areas of remnant habitat and/or in the floodplain of large tributaries of the Missouri River. The range for the amphibians is restricted, in general, to the Missouri River floodplain. Due to their secretive nature and life history habits, these species are hard to document through collection.

Table 18. Amphibians found in the Nodaway River basin in Missouri (Johnson 1987).

Common Name	Scientific Name	County*
Smallmouth salamander	*Ambystoma texanum*	A,H,N
Eastern tiger salamander	*Ambystoma tigrinum tigrinum*	A,H,N
Mudpuppy	*Necturus maculosus*	A
Plains spadefoot toad	*Scaphiopus bombifrons*	A,H
Eastern american toad	*Bufo americanus*	A,H,N
Great plains toad	*Bufo cognatus*	A,H
Woodhouse's toad	*Bufo woodhousei*	A,H,N
Blanchard's cricket frog	*Acris crepitans blanchardi*	A,H,N
Gray treefrog	*Hyla chrysoscelis- Hyla versicolor*	A,H,N
Western chorus frog	*Pseudacris triseriata*	A,H,N

Common Name	Scientific Name	County*
Great plains narrowmouth toad	*Gastrophryne olivacea*	A,H
Plains leopard frog	*Rana blairi*	A,H,N
Bullfrog	*Rana catesbeiana*	A,H,N
Northern leopard frog	*Rana pipens*	A

* - This represents presence at a county level. Part of the Nodaway River basin lies within each of the three counties. A = Andrew, H = Holt, N = Nodaway.

Table 19. Aquatic reptiles found in the Nodaway River basin in Missouri (Johnson 1987).

Common Name	Scientific Name
Common snapping turtle	*Chelydra serpentina serpentina*
Western painted turtle	*Chrysemys picta bellii*
Blanding's turtle	*Emydoidea blandingii*
Map turtle	*Graptemys geographica*
Mississippi map turtle	*Graptemys kohnii*
False map turtle	*Graptemys pseudogeographica pseudogeographica*
Red-eared slider	*Trachemys scripta elegans*
Midland smooth softshell	*Trionyx muticus muticus*
Western spiny softshell	*Trionyx spinifer hartwegi*
Blotched water snake	*Nerodia erythrogaster transversa*
Diamondback water snake	*Nerodia rhombifer rhombifer*
Northern water snake	*Nerodia sipedon sipedon*
Graham's crayfish snake	*Regina grahamii*
Western ribbon snake	*Thamnophis proximus proximus*
Red-sided garter snake	*Thamnophis sirtalis parietalis*
Massasauga rattlesnake	*Sistrurus catenatus*

THREATENED AND ENDANGERED SPECIES

Table 20 lists state and federal status of rare and endangered species for the Nodaway River basin in Missouri. Table 21 lists the rare and endangered species as well as high quality natural communities in the Iowa portion of the basin.

Table 20. Threatened and endangered species in the Nodaway River basin in Missouri (USFWS 1996, MDC 1997).

Common Name	Scientific Name	State Status	Federal Status
Flathead chub	*Platygobio gracilis*	Endangered	
Eastern massasauga rattlesnake	*Sistrurus catenatus catenatus*	Endangered	Candidate
Western fox snake	*Elaphe vulpina vulpina*	Endangered	
Blue lettuce	*Lactuca tatarica ssp. pulchella*	Endangered	
Great St. John's-wort	*Hypericum pyramidatum*	Endangered	
Wolfberry	*Symphoricarpos occidentalis*	Endangered	

Table 21. Threatened, endangered, species of concern and rare natural communities in the Iowa portion of the Nodaway River basin (K. Bogenschutz IADNR, personal communication).

Common Name	Scientific Name	State Status	Federal Status
Mead's milkweed	*Asclepias meadii*	Endangered	
Western Prairie fringed orchid	*Platanthera praeclara*	Threatened	
Southern mesic prairie			
Edwards hair streak	*Satyrium edwardsii*	Concern	
Long eared owl	*Asio otus*	Threatened	
Barn Owl	*Tyto alba*	Endangered	
Eastern spotted skunk	*Spilogale putorius*	Threatened	

Greater prairie chickens released in eastern Adair County, Iowa have been observed in the upper areas of the Nodaway River basin (K. Blazek, personal communication). A small greater prairie chicken population is located in southern Nodaway County but none have been observed in the Nodaway River Basin (Tom Nagel, MDC, personal communication).

Dr. Easterla indicated that the massasauga rattlesnake was historically collected in Nodaway County at what is now Bilby Ranch Lake Conservation Area. He has not seen or collected one there in over 30 years and considers them extirpated in that area although they are still occasionally encountered at Squaw Creek National Wildlife Refuge and Bigelow Marsh which are a few miles south of the Nodaway basin in Holt County.

Great blue heron rookeries were found in the Nodaway River basin in Missouri (MDC 1997).

FISH STOCKING

Fish stocking in the basin has been undertaken by three main entities, the IADNR, the MDC, and

private individuals. The majority of the basin's public lakes are found in Iowa and fall under management of the IADNR. The only public impoundments managed by the MDC are those at Bilby Ranch Lake CA and a few ponds on other conservation areas. A complete list of fish stocked in state managed waters can be found in Table 22. The MDC offers a stocking program for private ponds which meet the eligibility requirements. The MDC supplies largemouth bass, bluegill, and channel catfish to eligible pond owners for initial stocking. Additional information and pond stocking request can be gathered at the NW Regional MDC Office in St. Joseph. Walleye is another common species stocked in Iowa waters and saugeye have been stocked in Lake Icaria. Yellow bass and yellow perch have been collected in the Iowa portion of the basin, most likely from incidental stockings. They continue to spread throughout southern Iowa, though none have been documented in the Missouri portion of the basin.

Table 22. Fish stocked in the Nodaway River basin by the MDC and IADNR (J.Hudson and M. McGhee IADNR, personal communication and MDC NW Region files).

Water Body	County	Species Stocked
Bilby Ranch Lake	Nodaway	largemouth bass, channel catfish, bluegill, redear sunfish, fathead minnows
Greenfield Lake	Adair	largemouth bass, channel catfish, bluegill, black crappie, walleye
Lake Nodaway	Adair	largemouth bass, channel catfish, bluegill, black crappie, walleye
Lake Orient	Adair	largemouth bass, channel catfish, bluegill, black crappie
Mormon Trail	Adair	largemouth bass, channel catfish, bluegill, black crappie, walleye
Lake Icaria	Adams	largemouth bass, channel catfish, bluegill, black crappie, white crappie, walleye, saugeye, yellow bass*, yellow perch*
Nodaway Wildlife Area	Cass	largemouth bass, channel catfish, bluegill
Hacklebarney Woods	Montgomery	largemouth bass, channel catfish, bluegill, redear sunfish, *yellow bass
Viking State Park	Montgomery	largemouth bass, channel catfish, bluegill, black crappie, *yellow bass
Ross Park	Page	channel catfish, grass carp
Lake Binder	Page	largemouth bass, channel catfish, bluegill, black crappie, grass carp, yellow bass*, yellow perch*

* indicates incidental stocking

Grass carp have been stocked in numerous impoundments throughout the basin to control aquatic vegetation, and escapement has occurred. Natural reproduction has been documented in the lower Missouri River (Brown and Coon 1994). Common carp are also an introduced species which has a large presence in the basin and provide angling opportunities. Recently, bighead carp have been caught in the Nodaway River by anglers and are probably immigrating from the Missouri River where they have become established. Black and white crappie have been stocked in some state managed waters in Iowa and private impoundments throughout the basin.

CREEL SURVEY DATA

The only creel information available for the Nodaway River basin is the statewide general creel census compiled by John Funk (MDC) for the years 1946 through 1958. Channel catfish, common carp, and bullheads were the most frequently harvested fish in the Nodaway River basin during this time period. A creel survey to determine harvest, use, and attitudes of current anglers would be very useful in guiding future management of the Nodaway River basin waters.

PRESENT REGULATIONS

Statewide creel and fish size limits apply to the streams and rivers in the Nodaway River basin. Special regulations may apply to some public impoundments in the basin.

Appendix E. Common and scientific names and period collected for fish in the Nodaway River basin.

Common Name	Scientific Name	Collected Prior to 1957	Collected 1957-1979	Collected 1980-Present
Paddlefish	*Polyodon spathula*			X
Longnose gar	*Lepisosteus osseus*			X
Shortnose gar	*Lepisosteus platostomus*			X
Gizzard shad	*Dorosoma cepedianum*		X	X
Goldeye	*Hiodon alosoides*	X		X
Red shiner	*Cyprinella lutrensis*	X	X	X
Sand shiner	*Notropis ludibundus*	X	X	X
Bigmouth shiner	*Notropis dorsalis*			X
Emerald shiner	*Notropis atherinoides*		X	X
Fathead minnow	*Pimephales promelas*	X	X	X
Plains minnow	*Hybognathus placitus*	X		X
Suckermouth minnow	*Phenacobius mirabilis*	X	X	X
Flathead chub	*Platygobio gracilis*	X		X
Silver chub	*Macrhybopsis storeriana*	X	X	X
Speckled chub	*Macrhybopsis aestivalis*			X
Creek chub	*Semotilus atromaculatus*			X
Central stoneroller	*Campostoma pullum*			X
Common carp	*Cyprinus carpio*		X	X
Grass carp	*Ctenopharyngodon idella*			X
Bighead carp	*Hypophthalmicthys nobilis*			X
River carpsucker	*Carpiodes carpio*	X	X	X
Quillback	*Carpiodes cyprinus*		X	X
Plains carpsucker	*Carpiodes forbesi*			X
White sucker	*Catostomus commersoni*			X

Common Name	Scientific Name	Collected Prior to 1957	Collected 1957-1979	Collected 1980-Present
Blue sucker	*Cycleptus elongatus*			X
Shorthead redhorse	*Moxostoma macrolepidotum*			X
Smallmouth buffalo	*Ictiobus bubalus*			X
Bigmouth buffalo	*Ictiobus cyprinellus*			X
Channel catfish	*Ictalurus punctatus*	X	X	X
Flathead catfish	*Pylodictis olivaris*		X	X
Black bullhead	*Ameiurus melas*	X		X
Yellow bullhead	*Ameiurus natalis*			X
Stonecat	*Noturus flavus*			X
Yellow bass	*Morone mississippiensis*			X
Largemouth bass	*Micropterus salmoides*			X
Bluegill	*Lepomis macrochirus*			X
Green sunfish	*Lepomis cyanellus*		X	X
Redear sunfish	*Lepomis microlophus*			X
Orangespotted sunfish	*Lepomis humilis*			X
White crappie	*Pomoxis annularis*			X
Black crappie	*Pomoxis nigromaculatus*			X
Sauger	*Stizostedion canadense*		X	X
Walleye	*Stizostedion vitreum*			X
Saugeye	*Stizostedion canadense x Stizostedion vitreum*			X
Yellow perch	*Perca flavescens*			X
Freshwater drum	*Aplodinotus grunniens*			X

Appendix F. Table F-1. Collection of fish and relative abundance for Lincoln Creek in the Nodaway River basin, Missouri, June 17, 1997. Collectors Mike Bayless and Debbie Banks

(MDC). Collection Number: MB97-01. Location: T 60N, R 36W, Sec. 28. UTM: 4428120N/334000E.

Loc. No.	Coll. No.	Common Name	Taxa	Num. coll.	RA (%)
	MB97-01	Red Shiner	*Cyprinella lutrensis*	338	41.3
		Sand Shiner	*Notropis ludibundus*	205	25.0
		Bigmouth Shiner	*Notropis dorsalis*	170	20.8
		Creek Chub	*Semotilus atromaculatus*	50	6.1
		White Sucker	*Catostomus commersoni*	33	4.0
		Bluegill	*Lepomis macrochirus*	6	0.7
		Common Carp	*Cyprinus carpio*	5	0.6
		Fathead Minnow	*Pimephales promelas*	4	0.5
		Suckermouth Minnow	*Phenacobius mirabilis*	3	0.4
		Central Stoneroller	*Campostoma pullum*	2	0.3
		Orangespotted Sunfish	*Lepomis humilis*	1	0.1
		Channel Catfish	*Ictalurus punctatus*	1	0.1
		Yellow Bullhead	*Ameiurus natalis*	1	0.1
			TOTAL	**819**	

Appendix F. Table F-2. Collection of fish and relative abundance for Smith Creek in the Nodaway River basin, Missouri, June 23, 1997. Collectors Mike Bayless and Phil Boyles (MDC). Collection Number: MB97-02. Location: T 59N, R 37W, Sec. 11, NE 1/4. UTM: 4423940N/328180E.

Loc. No.	Coll. No.	Common Name	Taxa	Num. coll.	RA (%)
	MB97-02	Red Shiner	*Cyprinella lutrensis*	217	48.5
		Fathead Minnow	*Pimephales promelas*	52	11.6
		Creek Chub	*Semotilus atromaculatus*	51	11.4
		Sand Shiner	*Notropis ludibundus*	46	10.3
		Central Stoneroller	*Campostoma pullum*	31	6.9
		Green Sunfish	*Lepomis cyanellus*	21	4.7
		Bigmouth Buffalo	*Ictiobus cyprinellus*	14	3.1
		Black Bullhead	*Ameiurus melas*	7	1.6
		Channel Catfish	*Ictalurus punctatus*	5	1.1
		Yellow Bullhead	*Ameiurus natalis*	2	0.4
		Bigmouth Shiner	*Notropis dorsalis*	1	0.2
		Common Carp	*Cyprinus carpio*	1	0.2
			TOTAL	**448**	

Appendix F. Table F-3. Collection of fish and relative abundance for Nichols Creek in the Nodaway River basin, Missouri, June 23, 1997. Collectors Mike Bayless and Phil Boyles (MDC). Collection Number: MB97-03. Location: T 60N, R 37W, Sec. 17, NW 1/4. UTM: 4432600N/322620E.

Loc. No.	Coll. No.	Common Name	Taxa	Num. coll.	RA (%)
	MB97-03	Fathead Minnow	*Pimephales promelas*	44	38.5
		Largemouth Bass	*Micropterus salmoides*	26	22.8
		Creek Chub	*Semotilus atromaculatus*	22	19.3
		Green Sunfish	*Lepomis cyanellus*	13	11.4
		Yellow Bullhead	*Ameiurus natalis*	3	2.6
		Red Shiner	*Cyprinella lutrensis*	2	1.8
		Black Bullhead	*Ameiurus melas*	1	0.9
		Sand Shiner	*Notropis ludibundus*	1	0.9
		Central Stoneroller	*Campostoma pullum*	1	0.9
		Common Carp	*Cyprinus carpio*	1	0.9
			TOTAL	**114**	

Appendix F. Table F-4. Collection of fish and relative abundance for Pedlar Creek in the Nodaway River basin, Missouri, June 24, 1997. Collectors Mike Bayless and Debbie Banks (MDC). Collection Number: MB97-04. Location: T 61N, R 36W, Sec. 20. UTM: 4437740N/331600E.

Loc. No.	Coll. No.	Common Name	Taxa	Num. coll.	RA (%)
	MB97-04	Red Shiner	*Cyprinella lutrensis*	219	48.0
		Sand Shiner	*Notropis ludibundus*	81	17.8
		Bigmouth Shiner	*Notropis dorsalis*	62	13.6
		Creek Chub	*Semotilus atromaculatus*	30	6.6
		Fathead Minnows	*Pimephales promelas*	16	3.5
		Emerald Shiner	*Notropis atherinoides*	12	2.6
		Channel Catfish	*Ictalurus punctatus*	9	2.0
		Plains Minnow	*Hybognathus placitus*	8	1.8
		River Carpsucker	*Carpiodes carpio*	7	1.5
		Green Sunfish	*Lepomis cyanellus*	4	0.9
		Largemouth Bass	*Micropterus salmoides*	3	0.7
		Central Stoneroller	*Campostoma pullum*	2	0.4
		Bluegill	*Lepomis macrochirus*	2	0.4
		Bigmouth Buffalo	*Ictiobus cyprinellus*	1	0.2
			TOTAL	**456**	

Appendix F. Table F-5. Collection of fish and relative abundance for Elkhorn Creek in the Nodaway River basin, Missouri, June 24, 1997. Collectors Mike Bayless and Debbie Banks (MDC). Collection Number: MB97-05. Location: T 62N, R 37W, Sec. 15. UTM: 4449500N/325280E.

Loc. No.	Coll. No.	Common Name	Taxa	Num. coll.	RA (%)
	MB97-05	Red Shiner	*Cyprinella lutrensis*	460	69.0
		Sand Shiner	*Notropis ludibundus*	103	15.5
		Bigmouth Shiner	*Notropis dorsalis*	50	7.5
		Channel Catfish	*Ictalurus punctatus*	20	3.0
		Suckermouth Minnow	*Phenacobius mirabilis*	8	1.2
		Common Carp	*Cyprinus carpio*	6	0.9
		Fathead Minnow	*Pimephales promelas*	4	0.6
		Creek Chub	*Semotilus atromaculatus*	4	0.6
		River Carpsucker	*Carpiodes carpio*	3	0.5
		Yellow Bullhead	*Ameiurus natalis*	2	0.3
		Green Sunfish	*Lepomis cyanellus*	2	0.3
		Bluegill	*Lepomis macrochirus*	2	0.3
		Emerald Shiner	*Notropis atherinoides*	2	0.3
			TOTAL	**666**	

Appendix F. Table F-6. Collection of fish and relative abundance for Florida Creek in the Nodaway River basin, Missouri, June 25, 1997. Collectors Mike Bayless and Shawn Banks (MDC). Collection Number: MB97-06. Location: T 64N, R 37W, Sec. 35, N 1/2. UTM: 4464900N/327100E.

Loc. No.	Coll. No.	Common Name	Taxa	Num. coll.	RA (%)
	MB97-06	Red Shiner	*Cyprinella lutrensis*	252	48.2
		Sand Shiner	*Notropis ludibundus*	95	18.2
		Fathead Minnow	*Pimephales promelas*	55	10.5
		Suckermouth Minnow	*Phenacobius mirabilis*	26	5.0
		Bigmouth Minnow	*Notropis dorsalis*	23	4.4
		Creek Chub	*Semotilus atromaculatus*	21	4.0
		Channel Catfish	*Ictalurus punctatus*	18	3.4
		River Carpsucker	*Carpiodes carpio*	13	2.5
		Yellow Bullhead	*Ameiurus natalis*	9	1.7
		Green Sunfish	*Lepomis cyanellus*	5	0.9
		Largemouth Bass	*Micropterus salmoides*	2	0.4
		Common Carp	*Cyprinus carpio*	2	0.4
		Black Bullhead	*Ameiurus melas*	1	0.2
		White Crappie	*Pomoxis annularis*	1	0.2
			TOTAL	**523**	

Appendix F. Table F-7. Collection of fish and relative abundance for Jenkins Creek in the Nodaway River basin, Missouri, June 25, 1997. Collectors Mike Bayless and Shawn Banks (MDC). Collection Number: MB97-07. Location: T 62N, R 36W, Sec. 18, NE 1/4. UTM: 4450180N/330440E.

Loc. No.	Coll. No.	Common Name	Taxa	Num. coll.	RA (%)
	MB97-07	Red Shiner	*Cyprinella lutrensis*	189	43.9
		Sand Shiner	*Notropis ludibundus*	79	18.4
		Creek Chub	*Semotilus atromaculatus*	67	15.5
		Bigmouth Shiner	*Notropis dorsalis*	39	9.0
		Fathead Minnow	*Pimephales promelas*	39	9.0
		Channel Catfish	*Ictalurus punctatus*	7	1.6
		Emerald Shiner	*Notropis atherinoides*	5	1.2
		Suckermouth Minnow	*Phenacobius mirabilis*	3	0.7
		Bluegill	*Lepomis macrochirus*	2	0.5
		Green Sunfish	*Lepomis cyanellus*	1	0.2
			TOTAL	**431**	

Appendix F. Table F-8. Collection of fish and relative abundance for the Nodaway River near Nodaway, Missouri, July 2, 1997. Collectors Mike Bayless and Vince Travnichek (MDC). Collection Number: MB97-08. Location: T 59N, R 36W, Sec. 19. UTM: 4419620N/330300E.

Loc. No.	Coll. No.	Common Name	Taxa	Num. coll.	RA (%)
	MB97-08	Red Shiner	*Cyprinella lutrensis*	58	33.7
		Emerald Shiner	*Notropis atherinoides*	25	14.5
		Gizzard Shad	*Dorosoma cepedianum*	15	8.7
		River Carpsucker	*Carpiodes carpio*	14	8.1
		Common Carp	*Cyprinus carpio*	14	8.1
		Sauger	*Stizostedion canadense*	12	7.0
		Goldeye	*Hiodon alosoides*	9	5.2
		Bigmouth Buffalo	*Ictiobus cyprinellus*	5	2.9
		Shortnose Gar	*Lepisosteus platostomus*	4	2.3
		White Crappie	*Pomoxis annularis*	4	2.3
		Freshwater Drum	*Aplodinotus grunniens*	2	1.2
		Smallmouth Buffalo	*Ictiobus bubalus*	2	1.2
		Channel Catfish	*Ictalurus punctatus*	2	1.2
		Shorthead Redhorse	*Moxostoma macrolepidotum*	1	0.6
		Silver Chub	*Macrhybopsis storeriana*	1	0.6
		Largemouth Bass	*Micropterus salmoides*	1	0.6
		Flathead Catfish	*Pylodictis olivaris*	1	0.6
		Black Crappie	*Pomoxis nigromaculatus*	1	0.6
		Sand Shiner	*Notropis ludibundus*	1	0.6
			TOTAL	**172**	

Appendix F. Table F-9. Collection of fish and relative abundance for Clear Creek in the Nodaway River basin, Missouri, July 3, 1997. Collectors Mike Bayless and Shawn Banks (MDC). Collection Number: MB97-09. Location: T 66N, R 37W, Sec. 28, NE 1/4. UTM: 4485380N/331860E.

Loc. No.	Coll. No.	Common Name	Taxa	Num. coll.	RA (%)
	MB97-09	Red Shiner	*Cyprinella lutrensis*	141	44.9
		Bigmouth Shiner	*Notropis dorsalis*	109	34.7
		Sand Shiner	*Notropis ludibundus*	58	18.5
		Creek Chub	*Semotilus atromaculatus*	6	1.9
			TOTAL	**314**	

Appendix F. Table F-10. Collection of fish and relative abundance for the Nodaway River at Highway 46 near Skidmore, Missouri, July 9, 1997. Collectors Mike Bayless and Shawn Banks (MDC). Collection Number: MB97-10. Location Number: 1386. Location: T 64N, R 37W, Sec. 21. UTM: 4466760N/323300E.

Loc. No.	Coll. No.	Common Name	Taxa	Num. coll.	RA (%)
1386	MB97-10	Red shiner	*Cyprinella lutrensis*	443	89.0
		Sand Shiner	*Notropis ludibundus*	19	3.8
		Fathead Minnow	*Pimephales promelas*	11	2.2
		Emerald Shiner	*Notropis atherinoides*	6	1.2
		Largemouth Bass	*Micropterus salmoides*	5	1.0
		River Carpsucker	*Carpiodes carpio*	5	1.0
		Bigmouth Shiner	*Notropis dorsalis*	3	0.6
		Longnose Gar	*Lepisosteus osseus*	2	0.4
		Channel Catfish	*Ictalurus punctatus*	2	0.4
		Green Sunfish	*Lepomis cyanellus*	1	0.2
		Bluegill	*Lepomis macrochirus*	1	0.2
			TOTAL	**498**	
Additional fish species collected by electrofishing but numbers not recorded.			Common Carp - *Cyprinus carpio* White Crappie - *Pomoxis annularis* Flathead Catfish - *Pylodictis olivaris*		

Appendix F. Table F-11. Collection of fish and relative abundance for the Nodaway River at Highway 136 near Burlington Junction, Missouri, July 9, 1997. Collectors Mike Bayless and Shawn Banks (MDC). Collection Number: MB97-11. Location Number: 1385. Location: T 65N, R 37W, Sec. 17. UTM: 4478560N/322640E.

Loc. No.	Coll. No.	Common Name	Taxa	Num. coll.	RA (%)
1385	MB97-11	Red Shiner	*Cyprinella lutrensis*	383	78.4
		Sand Shiner	*Notropis ludibundus*	33	6.8
		Bigmouth Shiner	*Notropis dorsalis*	29	5.9
		Emerald Shiner	*Notropis atherinoides*	13	2.7
		River Carpsucker	*Carpiodes carpio*	6	1.2
		Fathead Minnow	*Pimephales promelas*	5	1.0
		Suckermouth Minnow	*Phenacobius mirabilis*	5	1.0
		Channel Catfish	*Ictalurus punctatus*	5	1.0
		Plains Minnow	*Hybognathus placitus*	4	0.8
		Creek chub	*Semotilus atromaculatus*	2	0.4
		Largemouth Bass	*Micropterus salmoides*	1	0.2
		White Crappie	*Pomoxis annularis*	1	0.2
		Green Sunfish	*Lepomis cyanellus*	1	0.2
		Common Carp	*Cyprinus carpio*	1	0.2
			TOTAL	**489**	

Appendix F. Table F-12. Collection of fish and relative abundance for the Nodaway River near Maitland, Missouri, July 31, 1997. Collectors Mike Bayless and Shawn Banks (MDC). Collection Number: MB97-12. Location Number: 957. Location: T 62N, R 37W, Sec. 9. UTM: 4452040N/323920E.

Loc. No.	Coll. No.	Common Name	Taxa	Num. coll.	RA (%)
957	MB97-12	Red Shiner	*Cyprinella lutrensis*	412	81.8
		Channel Catfish	*Ictalurus punctatus*	31	6.2
		Sand Shiner	*Notropis ludibundus*	22	4.4
		Emerald Shiner	*Notropis atherinoides*	15	3.0
		Fathead Minnow	*Pimephales promelas*	11	2.2
		River Carpsucker	*Carpiodes carpio*	5	1.0
		Green Sunfish	*Lepomis cyanellus*	2	0.4
		Suckermouth Minnow	*Phenacobius mirabilis*	2	0.4
		Speckled Chub	*Macrhybopsis aestivalis*	1	0.2
		Gizzard Shad	*Dorosoma cepedianum*	1	0.2
		Sauger	*Stizostedion canadense*	1	0.2
			TOTAL	**503**	

Appendix F. Table F-13. Collection of fish and relative abundance for the Nodaway River at I-29, July 9, 1997. Collectors Mike Bayless and Shawn Banks (MDC). Collection Number: 1387. Location Number: MB97-13. Location: T 60N, R 37W, Sec. 36. UTM: 4426360N/329540E.

Loc. No.	Coll. No.	Common Name	Taxa	Num. coll.	RA (%)
1387	MB97-13	Red Shiner	*Cyprinella lutrensis*	263	54.8
		Emerald Shiner	*Notropis atherinoides*	67	14.0
		Channel Catfish	*Ictalurus punctatus*	49	10.2
		Plains Minnow	*Hybognathus placitus*	21	4.4
		Common Carp	*Cyprinus carpio*	16	3.3
		Gizzard Shad	*Dorosoma cepedianum*	15	3.1
		River Carpsucker	*Carpiodes carpio*	12	2.5
		Sand Shiner	*Notropis ludibundus*	10	2.1
		Fathead Minnow	*Pimephales promelas*	7	1.5
		Bigmouth Buffalo	*Ictiobus cyprinellus*	6	1.3
		Flathead Catfish	*Pylodictis olivaris*	4	0.8
		Freshwater Drum	*Aplodinotus grunniens*	4	0.8
		Sauger	*Stizostedion canadense*	3	0.6
		Green Sunfish	*Lepomis cyanellus*	1	0.2
		Shortnose Gar	*Lepisosteus platostomus*	1	0.2
		White Crappie	*Pomoxis annularis*	1	0.2
			TOTAL	**480**	

Appendix F. Table F-14. Collection of fish and relative abundance for the Nodaway River at Highway 71 near Clearmont, Missouri, October 18, 1995. Collectors Scott Faiman and Brian Canaday (MDC). Collection Number: B95-143. Location Number: 956. Location: T 66N, R 36W, Sec. 6, W 1/2. UTM: 4491200N/328160E.

Loc. No.	Coll. No.	Common Name	Taxa	Num. coll.	RA (%)
956	B95-143	Red Shiner	*Cyprinella lutrensis*	186	68.8
		Sand Shiner	*Notropis ludibundus*	54	20.0
		Bluegill	*Lepomis macrochirus*	14	5.2
		Emerald Shiner	*Notropis atherinoides*	5	1.9
		Bigmouth Shiner	*Notropis dorsalis*	3	1.1
		Common Carp	*Cyprinus carpio*	2	0.7
		White Crappie	*Pomoxis annularis*	2	0.7
		Channel Catfish	*Ictalurus punctatus*	1	0.4
		Green Sunfish	*Lepomis cyanellus*	1	0.4
		Orangespotted Sunfish	*Lepomis humilis*	1	0.4
		Largemouth Bass	*Micropterus salmoides*	1	0.4
			TOTAL	**270**	

Appendix G, Table G-1. Collection of fish from the Middle Nodaway River in Adair County, Iowa, on October 24, 1990, by J. Olson (IADNR). Location: T 76N, R 32W, sec. 22 UTM: 4581160N/372860E

Common Name	Scientific Name
Sand Shiner	*Notropis ludibundus*
Bigmouth Shiner	*Notropis dorsalis*
Fathead Minnow	*Pimephales promelas*
Creek Chub	*Semotilus atromaculatus*
Green Sunfish	*Lepomis cyanellus*

Appendix G, Table G-2. Collection of fish from the Middle Nodaway River in Adair County, Iowa, on October 24, 1990, by J. Olson and T. Wilton (IADNR).Location: T75N, R32W, sec.02 UTM: 4575700N/375300E

Common Name	Scientific Name
Red Shiner	*Cyprinella lutrensis*
Sand Shiner	*Notropis ludibundus*
Bigmouth Shiner	*Notropis dorsalis*
Suckermouth Minnow	*Phenacobius mirabilis*
Fathead Minnow	*Pimephales promelas*
Creek Chub	*Semotilus atromaculatus*
Green Sunfish	*Lepomis cyanellus*

Appendix G, Table G-3. Collection of fish from the West Fork of the Middle Nodaway River in Adair County, Iowa, on October 24, 1990, by J. Olson and T. Wilton (IADNR). Location: T74N, R33W, sec.16 UTM: 4562260N/361900E

Common Name	Scientific Name
Red Shiner	*Cyprinella lutrensis*
Sand Shiner	*Notropis ludibundus*
Bigmouth Shiner	*Notropis dorsalis*
Fathead Minnow	*Pimephales promelas*
Creek Chub	*Semotilus atromaculatus*
River Carpsucker	*Carpiodes carpio*
Black Bullhead	*Ameiurus melas*
Green Sunfish	*Lepomis cyanellus*

Appendix G, Table G-4. Collection of fish from the West Fork of the Middle Nodaway River in Adair County, Iowa, on September 25, 1991, by J. Olson and T. Wilton (IADNR). Location: T75N, R33W, sec.22 UTM: 4571700N/363640E

Common Name	Scientific Name
Red Shiner	*Cyprinella lutrensis*
Sand Shiner	*Notropis ludibundus*
Bigmouth Shiner	*Notropis dorsalis*
Suckermouth Minnow	*Phenacobius mirabilis*
Fathead Minnow	*Pimephales promelas*
Creek Chub	*Semotilus atromaculatus*
River Carpsucker	*Carpiodes carpio*
Black Bullhead	*Ameiurus melas*

Appendix G, Table G-5. Collection of fish from the Middle Nodaway River in Adams County, Iowa, on October 24, 1990, by J. Olson and T. Wilton (IADNR). Location: T73N, R34W, sec.23 UTM: 4552740N/354240E

Common Name	Scientific Name
Common Carp	*Cyprinus carpio*
Flathead Chub	*Platygobio gracilis*
Red Shiner	*Cyprinella lutrensis*
Sand Shiner	*Notropis ludibundus*
Bigmouth Shiner	*Notropis dorsalis*
Suckermouth Minnow	*Phenacobius mirabilis*
Fathead Minnow	*Pimephales promelas*
Creek Chub	*Semotilus atromaculatus*
River Carpsucker	*Carpiodes carpio*
Plains Carpsucker	*Carpiodes forbesi*
Black Bullhead	*Ameiurus melas*
Channel Catfish	*Ictalurus punctatus*
Stonecat	*Noturus flavus*
Green Sunfish	*Lepomis cyanellus*
Bluegill	*Lepomis macrochirus*
Largemouth Bass	*Micropterus salmoides*

Appendix G, Table G-6. Collection of fish from the East Nodaway River in Adams County, Iowa, on August 7, 1991, by J. Olson and T. Wilton (IADNR). Location: T72N, R33W, sec.30 UTM: 4540020N/357040E

Common Name	Scientific Name
Common Carp	*Cyprinus carpio*
Red Shiner	*Cyprinella lutrensis*
Sand Shiner	*Notropis ludibundus*
Fathead Minnow	*Pimephales promelas*
River Carpsucker	*Carpiodes carpio*
Plains Carpsucker	*Carpiodes forbesi*
Shorthead Redhorse	*Moxostoma macrolepidotum*
Yellow Bullhead	*Ameiurus natalis*
Channel Catfish	*Ictalurus punctatus*
Green sunfish	*Lepomis cyanellus*
Largemouth Bass	*Micropterus salmoides*
Crappie	*Pomoxis sp.*

Appendix G, Table G-7. Collection of fish from the East Nodaway River in Adams County, Iowa, on August 7, 1991, by J. Olson and T. Wilton (IADNR). Location: T73N, R32W, sec.21 UTM: 4552180N/371000E

Common Name	Scientific Name
Common Carp	*Cyprinus carpio*
Red Shiner	*Cyprinella lutrensis*
Sand Shiner	*Notropis ludibundus*
Fathead Minnow	*Pimephales promelas*
River Carpsucker	*Carpiodes carpio*
Plains Carpsucker	*Carpiodes forbesi*
Channel Catfish	*Ictalurus punctatus*
Green Sunfish	*Lepomis cyanellus*
Largemouth Bass	*Micropterus salmoides*

Appendix G, Table G-8. Collection of fish from Sevenmile Creek in Cass County, Iowa, on September 25, 1991, by J. Olson and T. Wilton (IADNR). Location: T75N, R36W, sec.32 UTM: 4567720N/330640E

Common Name	Scientific Name
Red Shiner	*Cyprinella lutrensis*
Sand Shiner	*Notropis ludibundus*
Bigmouth Shiner	*Notropis dorsalis*
Suckermouth Minnow	*Phenacobius mirabilis*
Fathead Minnow	*Pimephales promelas*
Creek Chub	*Semotilus atromaculatus*
River Carpsucker	*Carpiodes carpio*
Stonecat	*Noturus flavus*
Green Sunfish	*Lepomis cyanellus*

Appendix G, Table G-9. Collection of fish from the West Nodaway River in Cass County, Iowa,

on September 25, 1991, by J. Olson and T. Wilton (IADNR). Location: T74N, R35W, sec.31 UTM: 4559460N/339160E

Common Name	Scientific Name
Red Shiner	*Cyprinella lutrensis*
Sand Shiner	*Notropis ludibundus*
Bigmouth Shiner	*Notropis dorsalis*
Fathead Minnow	*Pimephales promelas*
Creek Chub	*Semotilus atromaculatus*
River Carpsucker	*Carpiodes carpio*
Plains Carpsucker	*Carpiodes forbesi*
Yellow Bullhead	*Ameiurus natalis*
Channel Catfish	*Ictalurus punctatus*
Stonecat	*Noturus flavus*
Green Sunfish	*Lepomis cyanellus*
Largemouth Bass	*Micropterus salmoides*

Appendix G, Table G-10. Collection of fish from the West Nodaway River in Montgomery County, Iowa, on September 25, 1991, by J. Olson and T. Wilton (IADNR). Location: T73N, R36W, sec.16 UTM: 4553700N/332680E

Common Name	Scientific Name
Common Carp	*Cyprinus carpio*
Flathead Chub	*Platygobio gracilis*
Red Shiner	*Cyprinella lutrensis*
Sand Shiner	*Notropis ludibundus*
Suckermouth Minnow	*Phenacobius mirabilis*
Creek Chub	*Semotilus atromaculatus*
River Carpsucker	*Carpiodes carpio*
Plains Carpsucker	*Carpiodes forbesi*
Yellow Bullhead	*Ameiurus natalis*
Channel Catfish	*Ictalurus punctatus*
Green Sunfish	*Lepomis cyanellus*
Bluegill	*Lepomis macrochirus*

Appendix G, Table G-11. Collection of fish from the West Nodaway River in Montgomery County, Iowa, on September 26, 1991, by J. Olson and T. Wilton (IADNR). Location: T72N, R36W, sec.21 UTM: 4542260N/332300E

Common Name	Scientific Name
Common Carp	*Cyprinus carpio*
Red Shiner	*Cyprinella lutrensis*
Sand Shiner	*Notropis ludibundus*
Bigmouth Shiner	*Notropis dorsalis*
Suckermouth Minnow	*Phenacobius mirabilis*
Fathead Minnow	*Pimephales promelas*
Creek Chub	*Semotilus atromaculatus*
River Carpsucker	*Carpiodes carpio*
Plains Carpsucker	*Carpiodes forbesi*
Black Bullhead	*Ameiurus melas*
Channel Catfish	*Ictalurus punctatus*
Stonecat	*Noturus flavus*
Green Sunfish	*Lepomis cyanellus*
Bluegill	*Lepomis macrochirus*
Largemouth Bass	*Micropterus salmoides*

Appendix G, Table G-12. Collection of fish from the East Nodaway River in Page County, Iowa, on August 7, 1991, by J. Olson and T. Wilton (IADNR). Location: T67N, R36W, sec.06 UTM: 4500680N/329920E

Common Name	Scientific Name
Common Carp	*Cyprinus carpio*
Flathead Chub	*Platygobio gracilis*
Silver Chub	*Macrhybopsis storeriana*
Red Shiner	*Cyprinella lutrensis*
Sand Shiner	*Notropis ludibundus*
Fathead Minnow	*Pimephales promelas*
River Carpsucker	*Carpiodes carpio*
Quillback	*Carpiodes cyprinus*
Channel Catfish	*Ictalurus punctatus*
Green Sunfish	*Lepomis cyanellus*
Bluegill	*Lepomis macrochirus*

Appendix G, Table G-13. Collection of fish from West Mill Creek in Page County, Iowa, on September 4, 1991, by J. Olson and T. Wilton (IADNR). Location: T67N, R38W, sec.24 UTM: 4495880N/318040E

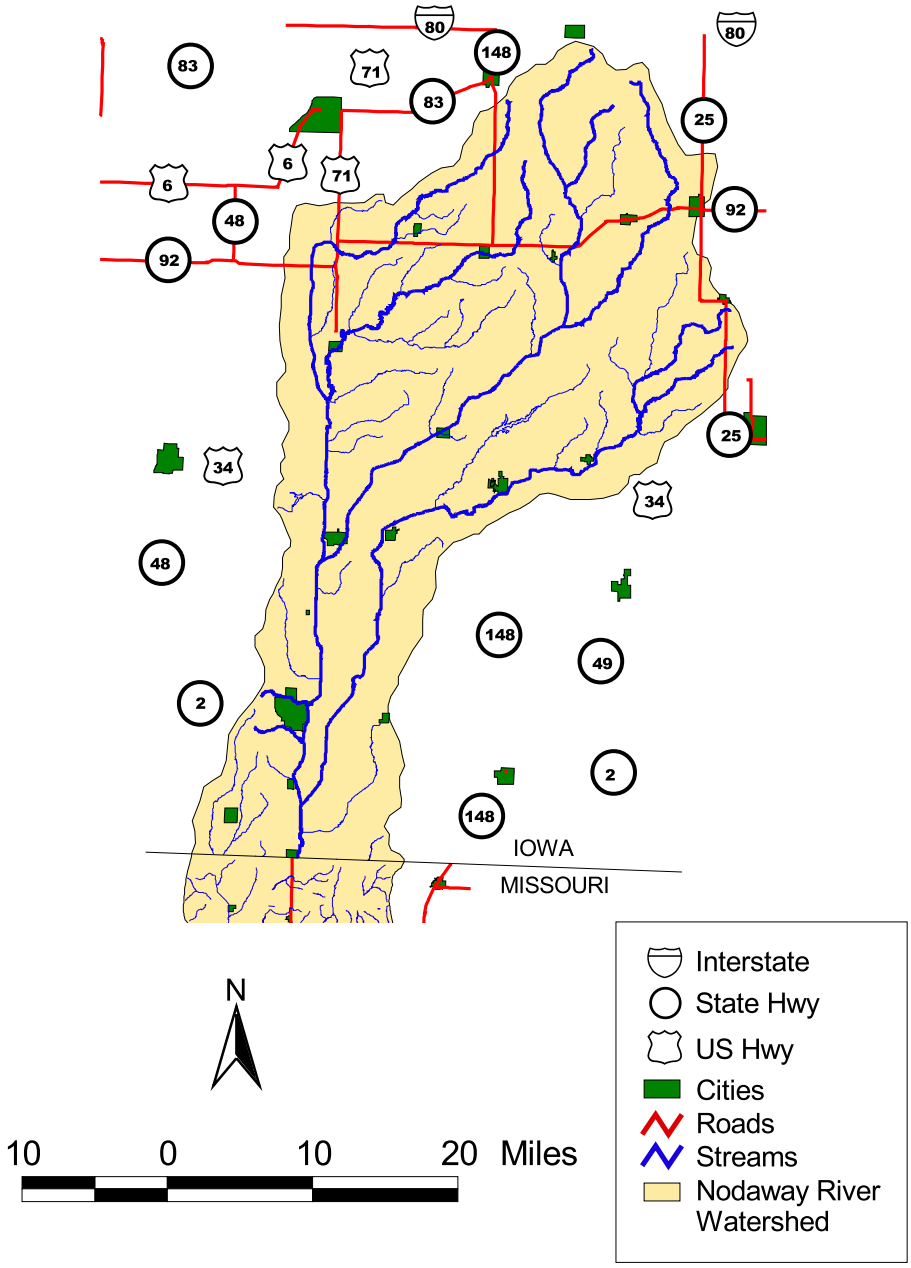
Common Name	Scientific Name
Central Stoneroller	*Campostoma pullum*
Red Shiner	*Cyprinella lutrensis*
Sand Shiner	*Notropis ludibundus*
Fathead Minnow	*Pimephales promelas*
Creek Chub	*Semotilus atromaculatus*
River Carpsucker	*Carpiodes carpio*
Plains Carpsucker	*Carpiodes forbesi*
Black Bullhead	*Ameiurus melas*
Yellow Bullhead	*Ameiurus natalis*
Channel Catfish	*Ictalurus punctatus*
Green Sunfish	*Lepomis cyanellus*
Bluegill	*Lepomis macrochirus*
Largemouth Bass	*Micropterus salmoides*

Appendix G, Table G-14. Collection of fish from the East Nodaway River in Page County, Iowa, on September 4, 1991, by J. Olson and T. Wilton (IADNR). Location: T69N, R36W, sec.13 UTM: 4515620N/336460E

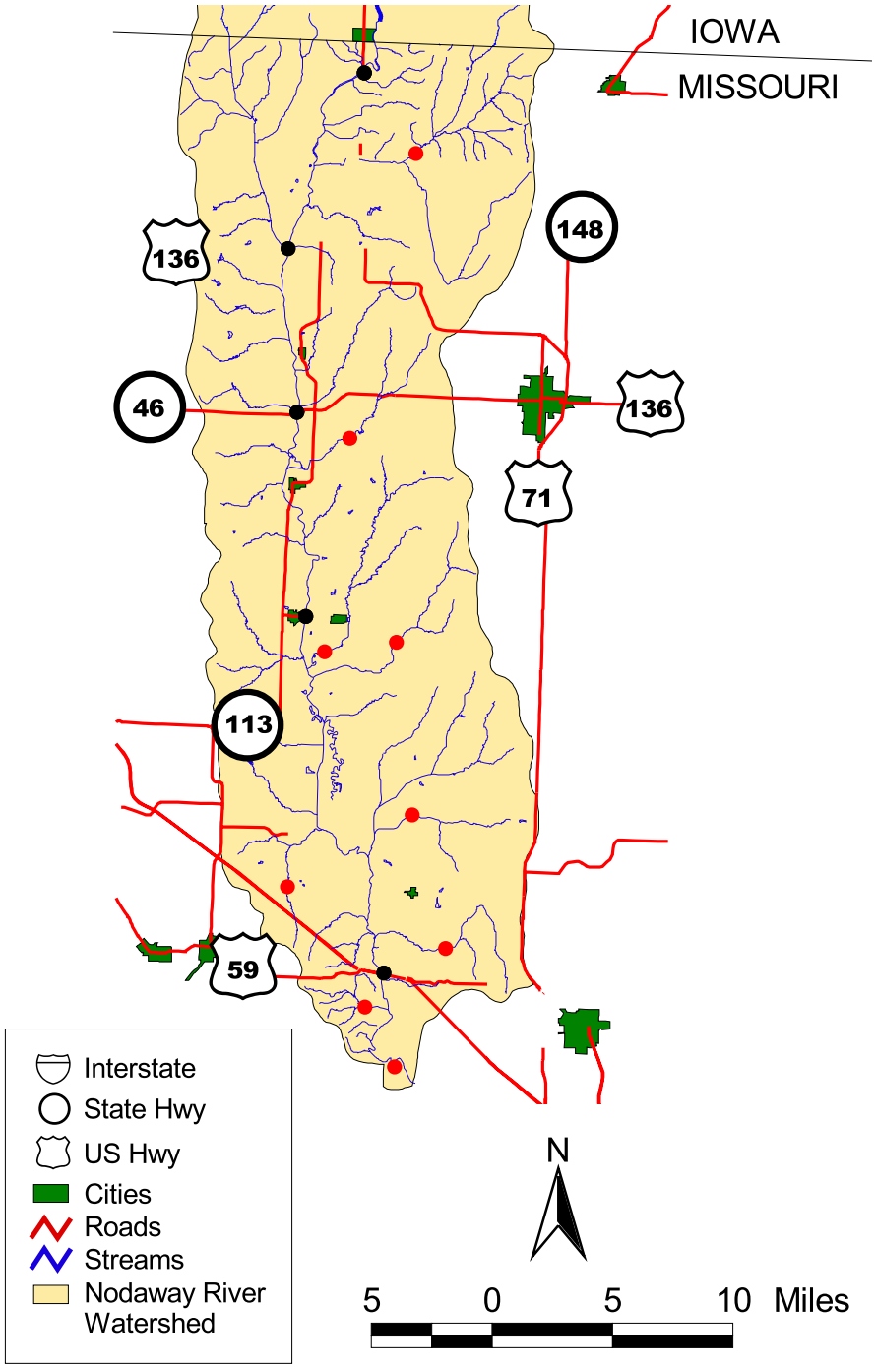
Common Name	Scientific Name
Central Stoneroller	*Campostoma pullum*
Flathead Chub	*Platygobio gracilis*
Red Shiner	*Cyprinella lutrensis*
Sand Shiner	*Notropis ludibundus*
Suckermouth Minnow	*Phenacobius mirabilis*
Fathead Minnow	*Pimephales promelas*
Creek Chub	*Semotilus atromaculatus*
River Carpsucker	*Carpiodes carpio*
Yellow Bullhead	*Ameiurus natalis*
Channel Catfish	*Ictalurus punctatus*
Stonecat	*Noturus flavus*
Flathead Catfish	*Pylodictus olivaris*
Green Sunfish	*Lepomis cyanellus*
Bluegill	*Lepomis macrochirus*
Largemouth Bass	*Micropterus salmoides*

Appendix H, Table H-1. Dragonflies found in the Nodaway River basin (Linden Trial, MDC Files).

Area Name	Location (T-R-Sec)	Common Name	Scientific Name	Date (M-Y)
Possum Walk Access	66N-37W-23	Common Whitetail	*Libellula lydia*	June 1997
Honey Creek CA	59N-36W-07	Common Whitetail	*Libellula lydia*	June 1997
Monkey Mountain CA	59N-37W-13	Green Darner	*Anax junius*	June 1997
		Common Whitetail	*Libellula lydia*	
		Twelve Spotted Skimmer	*Libellula pulchella*	
Nodaway Valley CA	61N-37W-15/16	Green Darner	*Anax junius*	Aug. 1997
		Eastern Pondhawk	*Erythemus simplicicollis*	
		Pied Skimmer	*Libellula luctuosa*	
		Common Whitetail	*Libellula lydia*	
		Twelve Spotted Skimmer	*Libellula pulchella*	
		Blue Dasher	*Pachydiplax longipennis*	
		Globe Glider	*Pantala flavescens*	
		Eastern Amberwing	*Perithemis tenera*	
		Black Mantled Glider	*Tramea lacerata*	
Bilby Ranch CA	64N-38W-22	Green Darner	*Anax junius*	Aug. 1997
		Eastern Pondhawk	*Erythemus simplicicollis*	
		Eastern Amberwing	*Perithemis tenera*	
		Black Mantled Glider	*Tramea lacerata*	
Maitland Access	62N-37W-09	Common Whitetail	*Libellula lydia*	Aug. 1997



Appendix D, Figure is. Location of fish sample sites in the Iowa portion of the Nodaway River watershed. Sites are represented by the red circles.



Appendix D, Figure ms. Location of fish sample sites in the Missouri portion of the Nodaway River watershed. Sites are represented by a black circle for a historic site and red circle for a new sites.

FISHERIES MANAGEMENT PROBLEMS AND OPPORTUNITIES FOR THE NODAWAY RIVER WATERSHED

MANAGEMENT PROBLEMS AND OPPORTUNITIES

The Nodaway River basin plan was developed to address objectives provided in the Missouri Department of Conservation Strategic Plan, Fisheries Division Operational Plan (FY 1996-2000), Stream Areas Program Plan, and the Stream Access Acquisition Plan. These plans indicate areas of future expanded resource management, public awareness, and access needs. Major areas of concern in the Nodaway River basin include water quality, riparian and aquatic habitat, aquatic communities, and recreational use. All goals are of equal importance, however, objectives are listed in order of priority under each goal. This plan only includes those items that the Missouri Department of Conservation can reasonably attain or influence during the next 25 years. Completion of these objectives will depend upon their status in overall Regional and Divisional priorities, as well as the availability of personnel and funds.

GOAL 1: IMPROVE WATER QUALITY AND MAINTAIN OR IMPROVE WATER QUANTITY IN THE NODAWAY RIVER BASIN SO THAT ALL STREAMS ARE CAPABLE OF SUPPORTING NATIVE AQUATIC COMMUNITIES.

Status: Streams within the Nodaway River basin suffer from several water quality problems associated with point and non-point source pollution. Turbidity and sedimentation from erosion, and animal waste from livestock operations are non-point sources of pollution in the basin. Sewage effluent from several waste water treatment facilities is the primary point source pollutant. The Conservation Reserve Program (CRP) has reduced the acreage of highly erodible soil that once was in row crop production. However, most contracts will expire by 1998, and this could result in CRP lands reverting back to row crop production. In addition, there is increased interest in construction of concentrated animal feeding operations that could result in an increase in livestock waste runoff.

Objective 1.1: Water quality standards are met in all streams within the basin.

Strategy: Enforcing existing state and federal water quality regulations will help reduce the number of violations that occur. Providing assistance in gathering additional water quality data within the basin will provide more information about stream conditions throughout the entire basin. This information can be used to provide justification for further protection and increased enforcement.

- Review NPDES, 404, and other permits and provide recommendations so that

compliance with water quality standards are maintained within the basin.

- Collect fish for contaminant analysis for the Missouri Department of Health and cooperate in advising the fishing public on the effects of contaminant levels in fishes within the basin.
- Cooperate with other state and federal agencies to investigate fish kill reports and other water quality related problems that are reported in the basin.
- Monitor water quality and insure compliance with discharge permits. Most of this work is under the jurisdiction of Missouri Department of Natural Resources, but with training, volunteer groups such as Stream Teams could assist with water quality monitoring and be strong advocates for water quality throughout the basin.
- Inform the public of water quality problems (i.e., sedimentation, livestock runoff, and sewage effluent) affecting streams in the basin through media and personal contacts, literature development and distribution, Stream Team promotion, and special or educational events such as National Hunting and Fishing Day.

Objective 1.2: Maintain base flows within the Nodaway River basin at or above current levels within the constraints imposed by natural seasonal variations in precipitation.

Strategy: Work closely with agricultural agencies to address concerns related to adequate streamflows within the basin. Work with state and local governments on laws and regulations pertaining to maintenance of base flows.

- Support the development of a Missouri water law that addresses the quantity of water in Missouri streams.
- Provide technical assistance for SALT and EARTH projects as requested by Soil and Water Conservation Districts so base flows can be maintained.
- Inform the public of water quantity problems affecting streams in the basin through media and personal contacts, literature development and distribution, Stream Team promotion, and events such as St. Joseph Sport Show and National Hunting and Fishing Day.

GOAL 2: IMPROVE OR MAINTAIN RIPARIAN AND AQUATIC HABITATS IN THE NODAWAY RIVER BASIN.

Status: Channelization and levees negatively affect riparian and aquatic habitats through increased stream bed and bank erosion, sedimentation, and by reducing wooded corridors, instream cover, and pool/riffle habitat complexes. Due to past channelization, many stream channels have down-cut below the root systems of trees so that the few trees remaining provide little, if any, streambank stabilization. In addition, landowners in the basin are reluctant to restore 100 feet wide vegetated corridors along each streambank because of the loss in row crop acreage.

Objective 2.1: Oppose most proposed channelization, re-channelization, or levee construction projects within the Nodaway River basin.

Strategy: Preventing future channel alterations will require a combination of watchdog activities that encourage enforcement of current laws, and educational programs. If these activities work, the need for law enforcement action in the future will be reduced.

- Review all 404 and other permits within the basin and provide comments on these applications to eliminate or minimize the impact of channelization and levee construction.
- Cooperate with MDC Outreach and Education Division in presenting materials related to stream ecology and effects of channelization to elementary and/or secondary schools within the basin.
- Riparian Easements?

Objective 2.2: Inform landowners within the Nodaway River basin about good stream stewardship practices and the importance of riparian corridors. Efforts to maintain and improve riparian conditions will be concentrated along the lower eleven miles of the mainstem Nodaway, Florida Creek, Nichols Creek, and Smith Creek, that were identified as possessing the best habitat within the Nodaway River basin in Missouri.

Strategy: Advertising and promoting stream incentive programs, installing and maintaining demonstration projects, and providing educational opportunities regarding stream stewardship will allow landowners to be more aware of the reasons and techniques for protecting streams. Promoting stream incentive programs for improving riparian habitats will likely encourage more landowners to participate. The majority of the Nodaway River basin is in Iowa, so technical assistance will be limited and will have to be directed at certain select segments of the basin in Missouri. Time and resources will have to be focused where the most benefit to the basin in Missouri is likely.

- Cooperate with Farm Service Agency (FSA), Natural Resources Conservation Service (NRCS), and University Outreach and Extension personnel to promote cost share programs that include streambank and streambed stabilization, alternate watering sources, excluding livestock access, and establishing and maintaining adequate stream corridors.
- Provide recommendations to all landowners who request assistance and are willing to establish and maintain adequate stream corridors.
- Provide stream management workshops for NRCS and University Outreach and Extension staff every five years for those people who have responsibilities for agriculture programs within the Nodaway River basin.
- Cooperate with NRCS and Soil and Water Conservation Districts to establish SALT and EARTH projects within the basin.
- Establish stream management demonstration sites within the basin.
- Promote sound land management practices that enhance stream quality through landowner workshops and demonstration site tours within the basin.
- Cooperate with MDC Outreach and Education Division in using streams within the basin for aquatic education programs.
- Coordinate and cooperate with Stream Teams to conduct riparian corridor improvement

projects (e.g. planting trees).

GOAL 3: MAINTAIN DIVERSE AND ABUNDANT POPULATIONS OF NATIVE AQUATIC ORGANISMS WHILE SUPPORTING ANGLER DEMANDS FOR QUALITY FISHING.

Status: A comprehensive survey of the fishes inhabiting the Nodaway River basin is needed in unsampled, or inadequately sampled streams. Several species of fish desirable to anglers are found in the basin. Channel and flathead catfish are the most sought after species, but sufficient samples to assess their populations are lacking. Very limited invertebrate sampling has been conducted, and a comprehensive study across the basin has not been conducted.

Objective 3.1: Assess and maintain native non-game fish populations and aquatic invertebrates at or above present levels throughout the basin.

Strategy: Assess the status of fish and invertebrate communities throughout the basin through a cooperative effort between MDNR, MDC, Iowa DNR, Iowa county conservation boards, Missouri Western State College, and Northwest Missouri State University. Achieving habitat objectives within the basin should ensure maintenance and improvement of aquatic communities. To determine if there are changes in aquatic communities within the basin, periodic surveys will need to be conducted with directed effort toward collecting indicator species (species sensitive to poor water quality) within the basin.

- Develop standard sampling techniques for assessing fish and aquatic invertebrate communities, including development and use of indicator species.
- Identify critical habitats for indicator species at all life stages and maintain or enhance these areas as needed to stabilize and/or increase populations.
- Implement a sampling program that monitors diversity and abundance of aquatic communities throughout the basin in cooperation with MDNR, Iowa DNR, Missouri Western State College, and Northwest Missouri State University. Through training, Stream Teams could provide additional information on aquatic communities within the basin.
- Enforcement of regulations pertaining to water quality and quantity, enhancement of riparian corridors, and improvement of instream habitat will help protect and enhance native aquatic communities within the basin.
- Consider artificial propagation and reintroduction of native species into historically occupied areas where habitat improvement is noted.

Objective 3.2: Evaluate sportfish populations within basin streams and provide recommendations for maintenance and improvement of these populations to a level that satisfies the angling public.

Strategy: Assess the quality of sportfish populations and provide recommendations for the enhancement of populations through regulations, habitat improvement, or stocking. A creel

survey to determine angler use, harvest, and attitudes should be done in the Nodaway basin. This information would be of utility in managing sportfish populations, and it would provide guidance for future management within the basin.

- Conduct a creel survey to determine angler use, harvest, and attitudes in the basin.

- Develop a standardized sampling method and implement a monitoring program to collect trend data to be used in evaluating and managing basin sportfish populations.
- Identify critical habitats for sportfish (primarily channel catfish) at all life stages and maintain or enhance these areas as needed to increase production.
- Improve populations of sportfish through regulations and habitat improvements once population objectives have been determined.
- Increase awareness of the recreational potential of fishes other than sportfish such as common carp, buffalo, gar, and freshwater drum through articles in local newspapers, outdoor magazines, and/or a possible *Missouri Conservationist* magazine article.

GOAL 4: INCREASE PUBLIC APPRECIATION FOR STREAM RESOURCES IN THE NODAWAY RIVER BASIN.

Status: Most citizens in the region lack an understanding and appreciation for the importance of stream resources. There is little regard for the well-being of streams within the basin.

Objective 4.1: Increase the level of public understanding of local stream resources and proper stream management practices.

Strategy: Increasing public awareness and knowledge of stream values should result in improvements in the level of appreciation for local stream resources. Enhanced awareness of streams within the basin should result in heightened concern about stream quality.

- Promote formation of Stream Teams within the basin through contacts with local civic organizations and schools.
- Locate local streams within the basin that are near schools that also possess adequate access for field trips.
- Cooperate with Missouri Western State College, Northwest Missouri State University, and the MDC Outreach and Education Division in using local streams in the basin for aquatic education programs.
- Promote the values of stream resources within the basin through local newspaper articles, radio, and television.

GOAL 5: INCREASE RECREATIONAL USE OF STREAMS IN THE NODAWAY RIVER BASIN.

Status: Turbid water, steep banks, straight channels, intensively farmed land, and limited access combine to limit recreation associated with basin streams. The Nodaway River is not floatable at certain times due to low flows and this also discourages visitation. Small scenic areas are found

in the basin, and with restoration of wooded corridors, increased public awareness, and better access, increases in use should be possible.

Objective 5.1: Increase recreational opportunities on and along streams within the basin.

Strategy: The MDC strategic plan calls for an increase in stream use to accommodate an overall increase in the level of use as construction of new reservoirs declines. Public satisfaction with existing recreational opportunities associated with streams in the basin needs to be determined. In addition, future acquisition sites, facilities, and recreational opportunities should be identified.

- Conduct creel, recreational use, and needs surveys periodically (at a minimum every 10 years) to determine public opinion and needs.
- Continue acquisition and development of stream access and frontage sites in the basin based on Stream Areas Program Strategic Plan and from Northwest Region MDC Fisheries staff recommendations.
- Increase recreational use at MDC sites in the basin using management plans tailored to take advantage of each area's natural features.

Objective 5.2: Recreationists have access to information on stream use opportunities in the basin.

Strategy: The public may not be aware of the recreational opportunities that currently exist in the basin. Publicity should increase use of basin streams. This in turn could lead to increased appreciation of the resource and foster the opinion that Nodaway River basin streams are worth protecting.

- Publicize recreational opportunities in the Nodaway River basin in local newspaper, radio, and television programs, and the MDC's web page.
- Include information from the Nodaway River basin in publications that promote hunting, fishing, floating, hiking, and other activities related to stream resources.
- Emphasize stream resources at public events such as the St. Joseph Sport Show and National Hunting and Fishing Day.

ANGLER GUIDE

FISHING PROSPECTS FOR THE NODAWAY RIVER IN MISSOURI

The lower eleven miles of the Nodaway River are the most popular for fishing. However, there are about 50 miles of river above this area in Missouri, not counting several small streams that empty into the mainstem Nodaway River, that are fishable. This upper area is often overlooked but can have good fishing too. Fishing in the Nodaway River can be very good for channel catfish and common carp. Other fish that may be caught in the river are flathead catfish, blue catfish, bullhead catfish, sunfish, sauger, and freshwater drum.

Channel Catfish

Common Carp

One popular method for catching channel catfish is to float or wade using a long pole (up to 15') and line baited with a minnow, worm, or stinkbait. The line usually has a weight attached to the end of it with a hook tied 6-8 inches above it. Any structure you find in the water (rootwads, rocks, bridge pilings, etc.) can and usually does harbor a catfish or two. The bait is placed into the water near these obstructions. If catfish are present they usually let you know in the form of a "bite" very quickly. If nothing happens in a couple of minutes it is time to move to the next piece of cover. Action can be fast and furious in the warmer months of the year.

Common carp are tremendous fighters when encountered on a fishing pole. Places to fish for carp would be in deeper holes wherever you can find them (around rocks, bridge pilings, etc.). A small treble hook covered with dough bait, whole kernel canned corn, or worms fished on the bottom can result in a close encounter with carp. A simple dough bait that will work is soft bread that is kneaded to make it more dense or the soft center from a cooked biscuit. There are many recipes for making dough baits. Ingredients range from cornmeal and breakfast cereals to flavored soda’s and Jell-O. If you want to try and make your own dough bait start at the local library. There are many books on fishing that have sections covering carp fishing. Usually the carp fishing section will have one or two basic dough ball recipes with a list of additional ingredients that can be added to change flavor, odor, and consistency.

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GLOSSARY

Alluvial soil Soil deposits resulting directly or indirectly from the sediment transport of streams, deposited in river beds, flood plains, and lakes.

Aquifer An underground layer of porous, water-bearing rock, gravel, or sand.

Benthic Bottom-dwelling; describes organisms which reside in or on any substrate.

Benthic macroinvertebrate Bottom-dwelling (benthic) animals without backbones (invertebrate) that are visible with the naked eye (macro).

Biota The animal and plant life of a region.

Biocriteria monitoring The use of organisms to assess or monitor environmental conditions.

Channelization The mechanical alteration of a stream which includes straightening or dredging of the existing channel, or creating a new channel to which the stream is diverted.

Concentrated animal feeding operation (CAFO) Large livestock (ie.cattle, chickens, turkeys, or hogs) production facilities that are considered a point source pollution, larger operations are regulated by the MDNR. Most CAFOs confine animals in large enclosed buildings, or feedlots and store liquid waste in closed lagoons or pits, or store dry manure in sheds. In many cases manure, both wet and dry, is broadcast overland.

Confining rock layer A geologic layer through which water cannot easily move.

Chert Hard sedimentary rock composed of microcrystalline quartz, usually light in color, common in the Springfield Plateau in gravel deposits. Resistance to chemical decay enables it to survive rough treatment from streams and other erosive forces.

Cubic feet per second (cfs) A measure of the amount of water (cubic feet) traveling past a known point for a given amount of time (one second), used to determine discharge.

Discharge Volume of water flowing in a given stream at a given place and within a given period of time, usually expressed as cubic feet per second.

Disjunct Separated or disjoined populations of organisms. Populations are said to be disjunct when they are geographically isolated from their main range.

Dissolved oxygen The concentration of oxygen dissolved in water, expressed in milligrams per liter or as percent.

Dolomite A magnesium rich, carbonate, sedimentary rock consisting mainly (more than 50% by weight) of the mineral dolomite ($CaMg(CO_3)_2$).

Endangered In danger of becoming extinct.

Endemic Found only in, or limited to, a particular geographic region or locality.

Environmental Protection Agency (EPA) A Federal organization, housed under the Executive branch, charged with protecting human health and safeguarding the natural environment --- air, water, and land --- upon which life depends.

Epilimnion The upper layer of water in a lake that is characterized by a temperature gradient of less than 1^o Celcius per meter of depth.

Eutrophication The nutrient (nitrogen and phosphorus) enrichment of an aquatic ecosystem that promotes biological productivity.

Extirpated Exterminated on a local basis, political or geographic portion of the range.

Faunal The animals of a specified region or time.

Fecal coliform A type of bacterium occurring in the guts of mammals. The degree of its presence in a lake or stream is used as an index of contamination from human or livestock waste.

Flow duration curve A graphic representation of the number of times given quantities of flow are equaled or exceeded during a certain period of record.

Fragipans A natural subsurface soil horizon seemingly cemented when dry, but when moist showing moderate to weak brittleness, usually low in organic matter, and very slow to permeate water.

Gage stations The site on a stream or lake where hydrologic data is collected.

Gradient plots A graph representing the gradient of a specified reach of stream. Elevation is represented on the Y-axis and length of channel is represented on the X- axis.

Hydropeaking Rapid and frequent fluctuations in flow resulting from power generation by a hydroelectric dam's need to meet peak electrical demands.

Hydrologic unit (HUC) A subdivision of watersheds, generally 40,000-50,000 acres or less, created by the USGS. Hydrologic units do not represent true subwatersheds.

Hypolemnion The region of a body of water that extends from the thermocline to the bottom and is essentially removed from major surface influences during periods of thermal stratification.

Incised Deep, well defined channel with narrow width to depth ration, and limited or no lateral movement. Often newly formed, and as a result of rapid down-cutting in the substrate

Intermittent stream One that has intervals of flow interspersed with intervals of no flow. A stream that ceases to flow for a time.

Karst topography An area of limestone formations marked by sinkholes, caves, springs, and underground streams.

Loess Loamy soils deposited by wind, often quite erodible.

Low flow The lowest discharge recorded over a specified period of time.

Missouri Department of Conservation (MDC) Missouri agency charged with: protecting and managing the fish, forest, and wildlife resources of the state; serving the public and facilitating their participation in resource management activities; and providing opportunity for all citizens to use, enjoy, and learn about fish, forest, and wildlife resources.

Missouri Department of Natural Resources (MDNR) Missouri agency charged with preserving and protecting the state's natural, cultural, and energy resources and inspiring their enjoyment and responsible use for present and future generations.

Mean monthly flow Arithmetic mean of the individual daily mean discharge of a stream for the given month.

Mean sea level (MSL) A measure of the surface of the Earth, usually represented in feet above mean sea level. MSL for conservation pool at Pomme de Terre Lake is 839 ft. MSL and Truman Lake conservation pool is 706 ft. MSL.

Necktonic Organisms that live in the open water areas (mid and upper) of waterbodies and streams.

Non-point source Source of pollution in which wastes are not released at a specific, identifiable point, but from numerous points that are spread out and difficult to identify and control, as compared to point sources.

National Pollution Discharge Elimination System (NPDES) Permits required under The Federal Clean Water Act authorizing point source discharges into waters of the United States in an effort to protect public health and the nation's waters.

Nutrification Increased inputs, viewed as a pollutant, such as phosphorous or nitrogen, that fuel abnormally high organic growth in aquatic systems.

Optimal flow Flow regime designed to maximize fishery potential.

Perennial streams Streams fed continuously by a shallow water table.

pH Numeric value that describes the intensity of the acid or basic (alkaline) conditions of a solution. The pH scale is from 0 to 14, with the neutral point at 7.0. Values lower than 7 indicate the presence of acids and greater than 7.0 the presence of alkalis (bases).

Point source Source of pollution that involves discharge of wastes from an identifiable point, such as a smokestack or sewage treatment plant.

Recurrence interval The inverse probability that a certain flow will occur. It represents a mean time interval based on the distribution of flows over a period of record. A 2-year recurrence interval means that the flow event is expected, on average, once every two years.

Residuum Unconsolidated and partially weathered mineral materials accumulated by disintegration of consolidated rock in place.

Riparian Pertaining to, situated, or dwelling on the margin of a river or other body of water.

Riparian corridor The parcel of land that includes the channel and an adjoining strip of the floodplain, generally considered to be 100 feet on each side of the channel.

7-day Q^{10} Lowest 7-day flow that occurs an average of every ten years.

7-day Q^{2} Lowest 7-day flow that occurs an average of every two years.

Solum The upper and most weathered portion of the soil profile.

Special Area Land Treatment project (SALT) Small, state funded watershed programs overseen by MDNR and administered by local Soil and Water Conservation Districts. Salt projects are implemented in an attempt to slow or stop soil erosion.

Stream Habitat Annotation Device (SHAD) Qualitative method of describing stream corridor and instream habitat using a set of selected parameters and descriptors.

Stream gradient The change of a stream in vertical elevation per unit of horizontal distance.

Stream order A hierarchial ordering of streams based on the degree of branching. A first order stream is an unbranched or unforked stream. Two first order streams flow together to make a second order stream; two second order streams combine to make a third order stream. Stream order is often determined from 7.5 minute topographic maps.

Substrate The mineral and/or organic material forming the bottom of a waterway or waterbody.

Thermocline The plane or surface of maximum rate of decrease of temperature with respect to depth in a waterbody.

Threatened A species likely to become endangered within the foreseeable future if certain conditions continue to deteriorate.

United States Army Corps of Engineers (USACE) Federal agency under control of the Army, responsible for certain regulation of water courses, some dams, wetlands, and flood control projects.

United States Geological Survey (USGS) Federal agency charged with providing reliable information to: describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect the quality of life.

Watershed The total land area that water runs over or under when draining to a stream, river, pond, or lake.

Waste water treatment facility (WWTF) Facilities that store and process municipal sewage, before release. These facilities are under the regulation of the Missouri Department of Natural Resources.